MÉMOIRES

ET

COMPTES RENDUS

DE LA

SOCIÉTÉ ROYALE

DU

CANADA

POUR L'ANNÉE 1885.

TOME III.

MONTRÉAL:
DAWSON FRÈRES, LIBRAIRES-ÉDITEURS.
1886.

PROCEEDINGS

AND

TRANSACTIONS

OF THE

ROYAL SOCIETY

OF

CANADA

FOR THE YEAR 1885.

VOLUME III.

MONTREAL:
DAWSON BROTHERS, PUBLISHERS.
1886.

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ROYAL SOCIETY OF CANADA.

PROCEEDINGS FOR 1885.

FOURTH GENERAL MEETING, MAY, 1885.

SESSION I. (*May 26th.*)

The Royal Society of Canada held its fourth general meeting in the Railway Committee room, Parliament Buildings, Ottawa, on Tuesday, May 26th. The President, Dr. T. Sterry Hunt, took the chair at 11 o'clock, A.M., and formally called the meeting to order.

The Honorary Secretary then read the following

REPORT OF COUNCIL.

The Council have the honour to submit their Annual Report.

The first volume of the Proceedings and Transactions, viz., that for the years 1882 and 1883, was duly distributed, and acknowledgments from the recipients of the same in many foreign countries have been very generally received. The Council have to state, moreover, that several Societies have already sent us exchanges, and that in this way the accumulation of a library of literary and scientific publications by the Society may be expected, for the reception of which provision must soon be made.

The publication of the second volume of Proceedings and Transactions, viz., that for the year 1884, was entrusted by the Council to a Committee consisting of Dr. T. Sterry Hunt, *Chairman*, Sir J. William Dawson, Dr. Louis Fréchette, Rev. J. Clark Murray, and Dr. Alex. Johnson, *Secretary*, The report of this committee is subjoined :—

" The Publication Committee have to report that the work of publication was by them entrusted to Messrs. Dawson Brothers of Montreal, who had already published and distributed Volume I in a very satisfactory manner, and have now issued Volume II, which has already been distributed throughout the Dominion, and in the next few weeks will be sent to foreign countries. As regards the work of editing, an important task for a volume of this kind, the publishers, with the approval of your Committee, made arrangements for the English part with Mr. R. W. Boodle of Montreal, a gentleman favourably known for his accuracy and critical scholarship, while, as regards the French, they were so fortunate as to secure the services of their colleague, Dr. Louis Fréchette. They have every reason to congratulate themselves on the ability and the care with which these gentlemen have performed a task, by no means easy, since in the publication of scientific papers, especially such as are found in Sections II, III and IV, there are many details as to letters, titles, proper names, etc., to learn the right use of which it was necessary to study carefully the best and the latest authorities.

That this important work of editing has been well performed will be seen by the highly complimentary letters from men so eminently qualified to judge as Dr. Daniel Wilson and Professor George Lawson.

"The Committee desire to call the attention of the Council to the importance of having all papers that are offered for publication carefully prepared and completely written out, before they are presented to the Society, and also to the necessity of each author's announcing in advance the number of printed pages which his paper will occupy.

"Of the second volume, as of the first, 1,500 copies have been printed and bound, besides which one hundred additional copies were printed and distributed in sheets to the several authors. The expenditures up to May 14th, 1885, for this work of publication are given in the accompanying memorandum from Messrs. Dawson Brothers. This it will be seen includes the cost of distribution for Volume I, but not for Volume II, and inasmuch as the cost of these two volumes has already reached about $10,000, the amount of the Parliamentary grant for the past two years, it is evident that the expense of distribution for Volume II must be paid from the $5,000 granted for 1885,—an obligation which will somewhat reduce the sum available for the publication of Volume III. In order that the Society may not find itself in debt at the end of the coming year, it is thought that the size of Volume III should not exceed 550 pages; on which account it is desirable that abstracts be published wherever possible.

"MONTREAL, May 14th, 1885.

"*The Royal Society of Canada.*

"To Dawson Brothers, Dr.

"For Balance from last account			$ 177.39
Account of Editing to date			187.94
Special Bindings of Extra copies			74.00
Foreign Freight and Express on Copies to Societies, Libraries, etc., to date, $181.66; less, $20.67			160.99
Cases, Packing, Shipping Expenses			50.00
Expenses of Committees			127.80
Postages			16.46
Domestic Freight and Express Charges			22.33
Extra Members' Copies			22.50
Corrections and Alterations			346.25
Illustrations			152.00
Binding			675.00
Paper, Composition and Press Work			2,934.50
			$4,947.16
"By Cash		$ 492.54	
"		1,050.00	
"		750.00	
"		125.00	
"		697.50	
"		987.34	
"		206.25	
"		350.00	
			4,658.63
"Balance			$ 288.53

"(Signed) ALEX. JOHNSON, *Secretary.*"

The meeting in Montreal of the British Association for the Advancement of Science in the month of August, 1884, being an event of interest to the men of letters and science in the Dominion, your Society, through its President, made to the British Association a formal address of welcome which was pronounced by him before the President and Council of the Association, and was as follows :—

"*To the President and Council of the British Association for the Advancement of Science.*

"MY LORDS AND GENTLEMEN :—The Royal Society of Canada greets with cordial welcome the members of your Association on the occasion of its first visit to the American Continent, and rejoices to find, among those who have accepted the invitation of the citizens of Montreal, so many names of men renowned as leaders of scientific research.

"The Royal Society of Canada, which is a body recently organized and in the third year of its existence, includes not only students of natural history and natural philosophy, who make up together one half of its eighty members, but others devoted to the history and the literature of the two great European races, who are to-day engaged in the task of building up in North America a new nation under the shelter of the British flag.

"Recognizing the fact that material progress can only be made in conjunction with advancement in literature and in science, we hail your visit as an event destined to give a new impulse to the labours of our own students,—believing at the same time, that the great problems of material nature not less than the social and political aspects of this vast realm, will afford you subjects for profitable study; and trusting that, when your short visit is over, you will return to your native land with kindly memories of Canada and a confidence that its growth in all that makes a people good and great is secured.

"(Signed) T. STERRY HUNT, *President.*
JOHN GEO. BOURINOT, *Hon. Secretary.*

"MONTREAL, August 27th, 1884."

The British Association for the Advancement of Science, at its late meeting in Montreal, appointed a committee to communicate with the Dominion on the important subject of Tidal Observations in Canada. Recognizing the expediency of cooperating with the British Association, the Council of the Royal Society appointed a committee to use all the means in their power to create an interest in a question, so immediately affecting the navigation of Canadian waters and so intimately connected with the security of the commerce of the country. In January last this committee, consisting of the President, the Honorary Secretary, Sir William Dawson, Principal Grant, and Professor Alex. Johnson, had the honour of an interview with the Minister of Marine and Fisheries, who evidently takes much interest in the matter, and promises to give it his fullest consideration. The Council of the Royal Society have also addressed memorials on the subject to the Privy Council and the Parliament of Canada. The following is a copy of the petition addressed to the House of Commons :—

"*To the Honourable Members of the House of Commons of the Dominion of Canada.*

"The Petition of the undersigned, members of the Council of the Royal Society of Canada, humbly sheweth :—That the British Association for the Advancement of Science, at its late meeting in Montreal, deemed it a matter of high importance, that the attention of the Parliament and Government of Canada should be drawn to the great need for Tidal Observations on the coasts of Canada, and to their great practical value in the interests of navigation; and appointed a committee to take steps to effect this object. The British Association has devoted much attention for many years to the subject of tides in general, and has endeavoured to secure greater accuracy and a wider range of observations, and at the same time to improve and develop the scientific methods for the prediction of the tides at any place where the observations have been taken; and consequently any communication

from the Association on this subject is deserving of special consideration, not merely as a matter of courtesy, but as likely to lead to measures highly advantageous to the Dominion.

"That the great deficiency in our knowledge of facts, on which to base trustworthy predictions of the tides for the different parts of our coasts, is a subject that might before this time have engaged the attention of the Royal Society, had it been longer in existence, not only for the high scientific interest of the problems involved, but also for the direct utility to seamen of the results depending on its solution. The Council, acting on behalf of the Society, desire therefore to urge with the utmost earnestness the importance, not only of establishing stations to obtain the requisite observations, and of reducing these observations, when obtained, by the methods of the British Association, but of doing this as speedily as possible, in order that information of such great value to the commerce of the country may be procured with the least possible delay. That your petitioners would also respectfully urge that besides observations, at fixed stations, on the rise and fall of the tides—which are specially connected with questions of 'soundings,'—a survey should be made by a properly equipped vessel or vessels to determine the rate and direction of the Tidal Currents at different times of the tide, want of knowledge of which has been the cause of the loss of so much life and property.

"They would gladly hope that before long they may see published in their Transactions papers with regard to the Atlantic and Pacific coasts, as valuable as those published in the Philosophical Transactions of the Royal Society of London by the late Admiral Beechey, giving the remarkable results of his survey of the currents of the Irish and English Channels and North Sea.

"Your Petitioners would, therefore, pray that your Honourable House will be pleased to take into your favourable consideration the foregoing facts, and sanction such measures as may secure those Tidal Observations on the coasts of Canada, which cannot fail to be of great practical value, not only to the scientific world at large, but to the many thousands of seamen who resort to the waters of the Dominion, and in that way to the growing commerce of the whole country.

"And your Petitioners as in duty bound will ever pray.

"(Signed) DR. T. STERRY HUNT.
ALEX. JOHNSON.
SIR W. DAWSON.
JOHN GEO. BOURINOT, *Hon. Sec.*,"
and others.

The customary invitations were sent to eminent scientific bodies in England, France, Belgium, and the United States, but they have been unable to send delegates to the present meeting for various reasons not necessary to state at length in this report. The following paragraph, from the reply of the President of the "Association française pour l'avancement des Sciences," demands the consideration of the Royal Society of Canada:—

"Our annual session will be held at Grenoble from August 12th to 23rd next, and we shall be much pleased if the Royal Society of Canada can be represented on that occasion. If this is possible, I shall be much obliged to you if you will let me know the number of delegates who, during their stay at Grenoble, will be the guests of the city and of the Association française."

We direct the attention of the scientific Sections to the desirability of appointing delegates in accordance with the foregoing cordial invitation.

The several scientific and literary Societies in the Dominion which have been affiliated with the Royal Society have been invited by circulars of the Honorary Secretary to elect delegates, to take part in all general and sectional meetings for the reading and the discussion of papers, and to communicate short statements of original work done and papers published during the year, and to report on any matters which the Royal Society may usefully aid by publication or otherwise. The following Societies have appointed Delegates, all of whom, we hope, will be present at this meeting:—

1. Geographical Society of Quebec.—*H. J. J. B. Chouinard.*
2. Literary and Historical Society of Quebec.—*Dr. John Harper.*
3. Nova Scotia Historical Society.—*J. G. Bourinot.*
4. Numismatic and Antiquarian Society of Montreal.—*R. W. McLachlan.*
5. Murchison Society of Belleville.—*W. R. Smith.*
6. Natural History Society of New Brunswick.—*W. F. Best.*
7. Natural History Society of Montreal.—*Dr. J. Baker Edwards.*
8. Ottawa Literary and Scientific Society.—*W. P. Anderson.*
9. Ottawa Field Naturalist Club.—*W. L. Scott.*
10. Société Historique de Montréal.—*Judge Baby.*
11. Hamilton Association.—*T. C. Keefer.*
12. Canadian Institute.—*Dr. Ellis.*
13. Entomological Society of Ontario.—*W. D. Harrington.*
14. Nova Scotian Institute of Natural Science.—*Professor Johnson.*

The Murchison Society of Belleville and the Hamilton Association having applied for affiliation with the Royal Society, and having appointed Delegates to this meeting, the Council would recommend to the Society that their request be acceded to, and their names be formally placed on the list.

The loss by death of M. Oscar Dunn during the last year makes a vacancy to be filled in Section I, and the same may be said of Section IV, where, by the death of Mr. Alexander Murray, the number of members in that Section is reduced to nineteen.

The Council beg leave to report that M. N. Bourassa, Dr. Osler, and Dr. Bernard Gilpin, having resigned their positions as Fellows of the Society, they be permitted to retain their titles, and be entered on the lists as retired members in accordance with the second paragraph of the seventh Rule of this Society.

The Council have also to report that the five following members are considered to have resigned in consequence of having failed to attend three years in succession, without presenting papers, or assigning reasons in writing satisfactory to the Society, as required by the third paragraph of the seventh Rule, viz., in Section I, M. Hector Fabre; in Section II, Professors Lyall, Watson, and Paxton Young; in Section IV, M. St-Cyr.

In order to facilitate business, the Council would also suggest that the Committee of each Section do meet for the purpose of arranging matters connected with each Section at 10 o'clock in the morning during the session, and that the Section itself do assemble half an hour after the meeting of such Committee.

The Council would also recommend that the authors of papers who are not Members be entitled to receive hereafter one copy of the Transactions of the Society.

List of Members Present.

The Honorary Secretary then called over the roll of Fellows, and the following gentlemen responded to their names:—

Abbé Bégin, Abbé Casgrain, Hon. M. Chauveau, M. Faucher de St-Maurice, M. Marmette, M. Sulte, Abbé Tanguay, Abbé Cazeau, Mr. John George Bourinot, Dr. Bucke, Rev. Æneas McD. Dawson, Mr. J. Lesperance, Mr. Evan McColl, Mr. J. Reade, Mr. Charles Sangster, Mr. George Stewart, jun., Dr. Withrow, Dr. Daniel Wilson, Mr. C. H. Carpmael, Dr. Fortin, Prof. Haanel, Very Reverend J. E. Hamel, Mr. Hoffman, Dr. T. Sterry Hunt, Prof. Loudon, Mr. T. Macfarlane, Dr. G. M. Dawson, Sir J. W. Dawson, Dr. J. A. Grant, Prof. Laflamme, Prof. Macoun, Mr. G. F. Matthew, Mr. W. Saunders, Mr. J. F. Whiteaves, Prof. Johnson, M. Tassé, Dr. Girdwood, Dr. Bayne, Prof. Chapman.

Report of the Committee on the Encouragement of Original Literary and Scientific Work.

Professor Alex. Johnson then read a Report, printed in full in the Appendix, from the Committee appointed at the last general meeting of the Royal Society.

On motion of Professor Loudon, seconded by Mr. George Stewart, jun., the Report was adopted.

On motion of Sir William Dawson, seconded by Mr. W. Saunders, the thanks of the Society were given to Dr. Johnson for the Report just adopted.

Resolutions.

The following motions were agreed to:—

1. That the names of the Murchison Society of Belleville and of the Hamilton Association be added to the list of those Societies affiliated with the Royal Society of Canada. (On the motion of Mr. Bourinot, seconded by Dr. Johnson.)

2. Que l'Académie des Sciences, Belles-Lettres et Beaux-Arts de Rouen soit sur sa demande mise sur la liste des correspondants de la Société Royale du Canada. (On the motion of M. Faucher de St-Maurice, seconded by the Hon. M. Chauveau.)

3. That the Honorary Secretary be authorized to print the abstracts of those papers which have been presented at least three weeks before the first day of the meeting and have been formally accepted, and to send copies of the same to the authors. (On the motion of Dr. Johnson, seconded by Mr. George Stewart, jun.)

4. Que la Société des gens de lettres de France soit mise sur la liste des correspondants de la Société Royale du Canada avec prière d'échanger les bulletins, documents, etc. (On the motion of M. Faucher de St-Maurice, seconded by M. Marmette.)

Reports from Affiliated Societies.

The Honorary Secretary then read again the list of Delegates, and the following Reports were submitted from the affiliated Societies:—

I. From the Literary and Historical Society of Quebec, through Dr. John Harper:—

I have the honour to represent, for the second time, that old institution, the Literary and Historical Society of Quebec, which still maintains its prestige among the literary and scientific associations of Canada, notwithstanding the difficulties of which I spoke in a former report. This year the Society has for its president, Mr. George Stewart, jun., a prominent member of the Royal Society; and, with his enthusiasm in all matters pertaining to English literature and Canadian history to guide the members in their researches, I have no doubt that the Society will continue to realize the purpose of its founders, and place on record its further progress as a means of interesting the citizens of the ancient capital and others in historical studies of a local character. The rooms of the Society continue to be a favourite resort for all who seek literary recreation, beyond the ordinary news-room. The library is kept in an excellent state of preservation, and, with the additions made to it from time to time, becomes more valuable to the general reader every year; while this year a catalogue has been prepared by our librarian of all the original essays and manuscripts published by the Society since its inception in 1824, which cannot but be of the greatest service to all those who continue to prosecute their investigations in matters pertaining to the early history of our country. As I reported last year, the Society is greatly crippled in its finances on account of the withdrawal of the grant received for many years from the Provincial Government, and the Council has found it impossible to continue its operations in the matter of publishing original documents. A suggestion has been made by a former member of the Society, on the floor of the House of Assembly, to the effect that the Government should purchase from the Society the manuscripts in its possession and publish

them under the supervision of the Provincial Secretary. This has been done in other instances; and were it done in the case of the Literary and Historical Society of Quebec, that Society would be freed from the responsibility of storing up literary material which it is unable to publish for lack of funds. In the matter of current expenses, the Treasurer has been forced to reduce the expenditure to the limits of bare expenditure, keeping out of debt, however, and expressing the hope that some public benefactor may yet come to his assistance and provide the means of carrying out more fully the purposes of the Society as set forth in its Royal Charter, viz., "the prosecution of researches into the early history of Canada; the recovering, procuring, and publishing of interesting documents and useful information as to the natural, civil and literary history of British North America, and for the advancement of the arts and sciences from which public benefit may be expected."

The visit of the British Association for the Advancement of Science was an event of great interest to the members of the Literary and Historical Society of Quebec, and several of its officers took an active part in making arrangements for the public reception of those of the scientists who found time to visit Quebec. Two of the members of the Council prepared a paper for distribution among the members of the Association as they arrived at Rimouski from Britain, its purpose being to call the attention of their distinguished visitors to the points of interest in Quebec and to the scenes which were worthy of notice on their way up the St. Lawrence towards the city. The compilers of the work were J. M. LeMoine, one of our past presidents, and J. M. Harper, one of the vice-presidents.

In the Annual Report, read on January 14th, 1844, mention is made of the death of three members of the Society—Messrs. McLean Stewart, J. B. Renaud and J. Brown, jun. There has been a slight decrease of members, the number of associates being at the present moment two hundred and thirty-nine, with twenty-three honorary and forty-two corresponding members,—the whole number being thus three hundred and four. Mr. Matthew Arnold, who favoured the Society with a lecture during the winter of 1883-4, has been elected an honorary member, and Mr. R. A. Brock of Richmond, Virginia, a corresponding member.

During the winter, a paper was read on Edward I by the President, the Hon. D. A. Ross, who retired from office in January, and a lecture was delivered by Lieut.-Col. William Rhodes on Geography.

The librarian, Mr. F. C. Wurtele, in making his report for the year, takes note of the fact that want of funds has greatly curtailed the purchase of books. One hundred and seventy-five of the members have availed themselves of the privilege of taking out books to the number of three thousand from the ten thousand on the shelves. Among other things, the librarian advises the reprinting of some of the historical documents in order to make the series prepared by the Society complete.

The officers of the Society for the present year are the same as last year, with the exception of a change of Presidents and the election of Mr. H. M. Price, and Lieut.-Col. Cotton to the Council.

In presenting this report from the oldest literary society in Canada to an association so full of promise as the Royal Society of Canada, I have to join with my associates in Council in expressing the regret that we cannot place on record an indication of greater activity in extending the influence of our Society. The condition of affairs in our city is not unfrequently animadverted upon by those who presume to sum up a city's prosperity in its commercial enterprise. If, however, the city of Quebec is not what it ought to be from a commercial standpoint—and he is but a faint-hearted Quebecer who has not hopes of improvement even in this respect—there is certainly no more delightful spot in Canada for the quiet prosecution of literary work and historical research, possessing, as it does, picturesque surroundings, unrivalled and teeming with historic interest. If Quebec and its enterprise are decaying, as some are inclined to think, it seems to me that a visitor, left to himself, would find some difficulty in detecting the evidence of such a state of affairs in the improvement of its squares and streets and public buildings. And so with her institutions. Though there is not to be found in their present condition the activity and growth of a younger town, there is anything but decay. As an evidence of this, I may say that in examining lately the annals of our Society with the intention of preparing a memoir of its Transactions, I have found in its changing fortunes a

record of the greatest interest; but in comparing the past of the Society with the present, I take some comfort in the fact that our affairs often presented a more striking appearance of decay in former years than they do at the present moment. Indeed, I feel that there lies before our Society a bright prospect of doing good work—a period of prosperity, let us hope, such as it enjoyed under the presidency of Mr. J. M. LeMoine, and others, years ago.

II. From the Nova Scotia Historical Society, through Mr. J. G. Bourinot:—

Since the last report to the Royal Society, the Nova Scotia Historical Society has added fourteen members to its roll, has held ten meetings, and has listened to eight papers, viz:—

1. Ships of war wrecked on the coasts of Nova Scotia and Sable Island in the eighteenth century, by S. D. Macdonald, F.G.S.

2. Sketch of the Hon. Simon Bradstreet Robie, Master of the Rolls, by Israel Longworth.

3, 4. Plans submitted to the British Government in 1763 by Sir Guy Carleton (Lord Dorchester): (1). For the founding of a Seminary of learning at Windsor in Nova Scotia; (2). For the establishment of an Episcopate in Nova Scotia, communicated by T. B. Akin, D.C.L.

5. Life of Samuel Vetch, the first English Governor of Nova Scotia, by the Rev. Geo. Patterson, D.D.

6. Exodus of the Negroes from Nova Scotia in 1791, with extracts from the Journal of John Clarkson, by the Hon. Sir A. G. Archibald, K.C.M.G.

7. Translation of the Saga of Eric the Red, written in the eleventh century, giving an account of the Discovery of Vineland, by Ove Lange, read by Peter Jack.

8. Early history of St. George's Parish and the trials of the early German settlers in Nova Scotia, by the Rev. Francis Partridge, D.D.

Besides these, numerous other papers are in course of preparation, and the Society has now in the printers' hands a fourth volume of collections containing, among other things, the first part of "Winslow's Journal," and an account of the ill-fated expedition to Quebec under Sir Hovenden Walker.

III. From the Entomological Society of Ontario, through Mr. W. Hague Harrington:—

As delegate from the Entomological Society of Ontario it affords me much pleasure to announce that the Society has continued to make satisfactory progress, both in membership and in the work which it undertakes. The monthly publication of the *Entomologist* brings before students of insects both in this country and abroad, very valuable and interesting papers on the habits and life-histories of our species, with frequent descriptions of new species discovered in our extensive country. Volume XVI has been completed and several valuable parts of Volume XVII have been already issued. The "Annual Report" No. xiv, issued by the Society, contains several instructive papers prepared especially for agriculturists, and is well supplied with such illustrations as may enable them to recognize the insects therein described. The Montreal Branch of the Society is in a flourishing condition, which is due to the exertions of the energetic and enthusiastic entomologists who reside in that city.

Gratification is felt at the evidence of a growing interest in regard to the very important question of the serious losses annually caused throughout the country by the depredation of various insects. The Select Committee appointed by Parliament in 1884 to obtain information as to the Agricultural Interests of the Dominion, issued circulars to a large number of leading fruit-growers and other agriculturists throughout the country, requesting, among other points, an expression of opinion as to the desirability of the appointment of a Government Entomologist. A large majority of the answers were in favour of such an appointment. Two members of the Council of the Entomological Society

were also called, and gave evidence, before the Committee, as to the ravages of insects in Canada, and as to the advantages which would result from the appointment of a competent Entomologist. The Department of Agriculture, impressed by the importance of the subject as thus brought before its notice, has since appointed as Entomologist one of the most energetic officers and workers of our Society, Mr. James Fletcher, who has issued a Preliminary Report, briefly describing the most noticeable injuries caused by insects last season to the various crops.

In the United States great attention is still paid to the study of economic entomology. Several of the States, as well as the Federal Government, make liberal provisions for the investigations of appointed Entomologists. The published reports of such investigations are exceedingly valuable; and furnish, with the exception of that supplied by the Entomological Society of Ontario, almost the only reliable information regarding the injurious insects infesting our orchards, fields and gardens.

It is a matter of no little importance that as full information as can be obtained should be circulated as widely as possible among our farmers, and to this end the appointment of an Entomologist by the Department of Agriculture is an important step in the right direction.

IV. From the Ottawa Field-Naturalists' Club, through Mr. W. L. Scott:—

As delegate from the Ottawa Field Naturalists' Club I am able to report that the last year has been for it one of continued progress and success. Its twofold work of studying local natural history, and of endeavouring to popularize science has been vigorously prosecuted and its membership has been largely increased. Forty persons joined the Club during the year, of whom several reside in distant parts of the country and have sought to evidence their interest in the welfare of the Club by enrolling themselves in its ranks. The membership is now one hundred and seventy.

Four large excursions were held last summer, at the first of which the Club was honoured by the presence of many fellows of your honourable Society, and delegates thereto. Sub-excursions of working parties were also held on alternate Saturdays during the season and contributed largely to a fuller knowledge of our geological formations and of our fauna and flora.

At the winter Soirees (six in number), Reports by the leaders appointed in Zoology, Botany, Entomology, Conchology, Ornithology and General Zoology, were presented, and the following papers of much interest and value were read:—

1. The President's Address, by Dr. H. Beaumont Small.
2. The Canadian Otter, by W. Pitman Lett.
3. The Minerals of the Ottawa District, by C. W. Willimott.
4. Wheat (with special reference to that grown in Ottawa District), by William Scott.
5. Our Saw-flies and Horn-tails, by W. H. Harrington.
6. Local Trenton Fossils, by W. B. Billings.

Classes in Botany, Mineralogy and Ornithology were conducted during several weeks,—the first-named subject, under the very interesting treatment of Professor Macoun, being specially attractive to the members and their friends.

It has been the aim of the Club since its formation to make its published Transactions as complete and valuable as its circumstances will permit, and No. 5 (Vol. II. No. 1, pp. 152) which was published during the year, is one which would be creditable to any older and wealthier Society. No. 6, which is now in the hands of the Publishing Committee, will contain the Report and Papers before referred to, as well as Annual Reports of Librarian, Treasurer, Council, etc.

The library of the Club has received numerous valuable donations and exchanges, including the magnificent volume of the Transactions of your honourable Society, for which I am instructed to convey to you the thanks of the Club.

At the Annual Meeting of the Club, held on March 17th last, the following Officers were elected for the year 1885-86 :—

President	W. H. Harrington.
1st Vice-President	John Macoun.
2nd do	S. S. Woods.
Secretary	James Fletcher.
Treasurer	T. J. MacLaughlin.
Librarian	W. L. Scott.
Committee	F. D. Adams, Henry M. Ami, Rev. C. F. Marsan.

V. From the Nova Scotian Institute of Natural Science, through Dr. J. G. MacGregor :—

The Institute has just concluded a somewhat successful session. I say "somewhat" successful, because we feel the effect of the establishment of the Royal Society in a diminution of the number and value of the communications brought before us,—the more important papers being naturally contributed to your Society. We hope, however, that before very long, the establishment of the Royal Society may result in a stimulus which will produce so much energetic work, that the Transactions of both the central and the local Societies may be large as to number and valuable as to contents.

The scientific communications of the past Session have been as follows :—

1. Geological Notes of Excursions in Nova Scotia with members of the British Association, by Rev. Dr. Honeyman, D.C.L.
2. On Feather Alum Halotrichite, by Edwin Gilpin, A.M.
3. On new or rare plants of Nova Scotia, by Prof. G. Lawson, Ph. D., LL.D.
4. Louisburg, past and present,—historico-geological, by Rev. D. Honeyman, D.C.L.
5. List of Plants collected round Truro, Nova Scotia, by G. G. Campbell, B. Sc.
6. On Fresh-water Sponges of Nova Scotia, by A. H. McKay, B.A., B. Sc.
7. Note on Temperatures of Maximum Density, by Prof. J. G. MacGregor, D.Sc.
8. Nova Scotian Ichthyology,—additions to the Catalogue of Nova Scotian fishes, by Rev. Dr. Honeyman, D.C.L.

During the session, the Institute has spent a good deal of time in a careful revision of its laws. I send you herewith a copy of the laws as finally passed.

I embrace this opportunity of suggesting that the Royal Society should take steps to promote co-operation in the work of our local Societies. There are many kinds of scientific work, such, for instance, as the observation of the migration of birds, which can only be carried on with complete success by means of simultaneous observations over the whole country. Might it not be well to appoint a Committee, consisting of Fellows of the Royal Society and Delegates of affiliated Societies, to draw up a series of recommendations as to work of this kind and modes of carrying it out? Reports of the work carried out by the local Societies on the lines of this Committee's recommendations might be published in full in their Transactions, and a General Report might be published by the Central Committee in the Transactions of the Royal Society.

SESSION II. (*Afternoon Sitting.*)

Addresses by the President, Vice-President and Dr. Chauveau.

The fellows and delegates again assembled in the Railway Committee Room at 2 o'clock. His Excellency the Governor-General, the Marquis of Lansdowne, took his seat as Honorary President, and called upon the President to deliver the opening address.

The following is an abstract of the address of the President, Dr. T. Sterry Hunt:—

The President, in opening the session, congratulated the Society on the work that it had accomplished during the past year, and referred to the two quarto volumes of its Transactions published in 1883 and 1884, and already distributed among the principal libraries and institutions of learning throughout the world, as showing that Canada was adding somewhat to the progress both of literature and of science. He spoke with feeling of the loss by death of two of the members of the Society during the past year. One of these, Mr. Oscar Dunn, a young man of great promise in French literature, had distinguished himself, not only in Canada, but in the world of journalism in Paris. The other, Mr. Alexander Murray, was for more than twenty years a member of the Geological Survey of Canada under the late Sir William Logan, and had done much to make known the geology and physical geography of the great lakes and the valleys of the Ottawa and St. Lawrence, before he was called to direct the geological survey of Newfoundland, where he rendered important services to science.

The Royal Society of Canada has before it vast fields of labour, alike in history, in antiquity, and in natural science. After alluding briefly to the territory of Canada as a battle-ground upon which, for a century, two great European races were contending for the mastery of the continent in a prolonged struggle, the study of which affords precious material alike for the man of letters and the philosophic historian, he passed to a review of some of the problems which lie before the members of the two scientific Sections of the Society. Vast regions now belonging to the Dominion of Canada, stretching from the lakes to the Arctic sea, and from ocean to ocean, are still to a great extent unexplored. These present important questions in geography and geology, and in the study of their fauna and flora. Closely connected with this subject is that of the correct determination of longitudes. Twenty-five years ago much uncertainty existed as to the precise location on the map of the globe of our Canadian cities. It was then that the Geological Survey undertook to fix the longitude of Quebec, Montreal, and other places, by the electrical method, and with excellent results. Within the past few years, however, methods admitting of greater accuracy have been devised, and, by the help of these, the longitude of Cambridge, Massachusetts, as compared with that of Greenwich, has been carefully redetermined. It hence became of importance that the exact longitude of Canadian cities with reference to Cambridge should be fixed, and the results of a series of careful observations, under the combined direction of Professor Rogers of the Cambridge Observatory and members of our Society, will be laid before the physical Section of our Society and published in our Transactions.

The geography of our sea-coasts presents problems of great importance. The Pacific shores of the Dominion are but little known, and our Atlantic waters are subject to strong tides and local currents which are sometimes disastrous to navigators. Other nations have done much to investigate and to systematize the knowledge of tides and marine currents, and Canada, in view of her important commercial marine, should take part in such work. The Dominion Government has been solicited to cooperate with a joint committee composed of members of the British Association for the Advancement of Science together with members of our own Society, and there are good hopes that systematic labours will soon be commenced both on our Pacific and our Atlantic shores. Not remotely connected with the last subject is that of our fisheries. Much attention has already been given to those of the inland waters, but the scientific cultivation of the marine fisheries and the care of those vast meadows of the sea, so rich in food, has hitherto been neglected. The systematic work of the United States

Fish Commission affords a model for imitation, and the zoologists of our Society cannot do better work than by insisting upon the claims of this great branch of national industry to the attention of the Government.

Our forests are perhaps even of greater value to the Dominion than the fisheries. For many years they have been a great source of wealth to the country, and, during all these years, the lumberer has been wasting them. In other lands, great time and attention are devoted to forestry, and the modes of planting, pruning and protecting trees are carefully studied, but on this continent the subject has hitherto been much neglected. The early settlers, who looked upon the forest as their enemy, and as the hiding place of savage beasts and more savage men, thought only of its destruction. Now, with the disappearance of wood, so needful as a fuel in our rigorous climate, we are beginning to prize the forests and to lament their premature disappearance. The establishment of botanic gardens and schools of forestry, in which the various problems, connected alike with agriculture and with the growth and preservation of trees for timber and for fuel, may be carefully investigated, are subjects near to every one who desires the prosperity of the country, and should not be lost sight by the members of this Society.

In conclusion, the President insisted upon the many reasons for congratulation on the success which had attended the past three years of the Society's existence, and for looking forward to a useful and a brilliant future.

The Vice-President, Dr. Daniel Wilson was next called upon by His Excellency. He observed that he thought it was fortunate for Canada that it had taken the step of organizing this Society before the meeting of the British Association on Canadian soil, thereby testifying that our recognition of the value of abstract science was alike hearty and spontaneous. There was no lack of appreciation of the worth of such contributions of science as the telegraph and the ocean cable, which, as it were, annihilate time and space, and bridge over for us the wide Atlantic; of the telephone, with all its marvellous facilities and still grander possibilities of inter-communication; or of electric light, by which at will we turn night into day. Our legislature had, for many years, liberally subsidized the Geological Survey, to find for us coal and copper, gold, silver, lead and other minerals, and to map out for us in economic detail the physical resources of our vast domain. But this recognition of science, for its own sake, was a grand step in advance. It furnished the best evidence that Canada had passed beyond the mere elementary stage of narrow utilitarianism, and had awakened to some just sense of the value of that self-denying search for abstract truth in all its scientific relations, without which such practical results as those already referred to could no more be secured than the autumn harvest without the labours of the seed time.

After the comprehensive summary of the efforts and achievements of the past year, which they had just listened to from their President, it would be a work of supererogation for him to detain His Excellency and the members with further remarks, were it not that one subject had still a special claim on their attention. Dr. Sterry Hunt had, not unnaturally, given prominence to physical science; but not only did the Society embrace in a special manner the literature of two of the most cultivated languages of Europe, but along with this it included archæology, ethnology and comparative philology; and, in the last two, encouragement was given to researches into the races and languages of this continent, and especially of our Dominion, to which too much importance could not be attached. The races of our great Northwest are vanishing. Now or never the materials must be collected from which to deduce scientific results. We can only preserve any remnant of our aborigines by a process of civilization and absorption which involves the loss of language, of native art, and all else that is of value to the historian and the ethnologist. To this, therefore, it is indispensable that immediate attention be given; for it is work that must be done now or never.

Again, the language of France, the old France of the Regency and long before it, as brought from Normandy and Brittany, survives in the Province of Quebec in modified forms replete with interest to

the philologist. To these and to other branches of kindred study, embraced alike in the departments of ethnology and history, the labours of Sections I and II, are invited with a special, if not indeed a preeminent claim on their attention, and with the promise of result full of interest and value to us all.

Dr. Chauveau, at the request of His Excellency, next addressed the meeting as follows :—

Milord,—Veuillez me permettre de vous remercier de m'avoir appelé à prendre la parole, contrairement à l'usage qui réserve cet honneur au président et au vice-président. J'apprécie pleinement le motif de cette gracieuse invitation : on veut que la langue française soit représentée. Je regrette d'en avoir été prévenu il y a quelques heures seulement, et cela d'autant plus que M. le président qui s'est exprimé en un français très élégant à une séance de la première section, l'année dernière, aurait pu peut-être remplir ici une double tâche.

Ç'a été une heureuse idée que de réunir dans une même société les sciences et les lettres, qui se touchent de si près, que plusieurs hommes célèbres en France ont fait ou font partie de l'Académie française en même temps que de l'Académie des sciences. Aussi M. Hunt et plusieurs membres des sections scientifiques se sont-ils trouvés tout à fait à l'aise dans les séances des sections littéraires. Je n'oserais dire que la réciprocité soit parfaite sous ce rapport, et il y a tel mémoire de la section des sciences physiques et mathématiques qui ne chatouillerait pas bien agréablement l'oreille de nos hommes de lettres. On fait plus facilement d'un savant un littérateur que d'un littérateur un savant.

Je ne puis, du reste, qu'approuver tout ce que M. Hunt a dit sur l'accueil bienveillant que la Société Royale a reçu du public canadien et de l'étranger, et sur l'importance des devoirs que nous avons à remplir pour justifier pleinement la confiance que l'on nous a témoignée.

Je me permettrai d'appuyer sur une partie du discours de M. le président, non pas pour y ajouter beaucoup, mais plutôt pour confirmer par mon témoignage l'éloge qu'il a fait de notre regretté collègue, M. Oscar Dunn.

Il a dit avec raison que M. Dunn avait été un exemple frappant des singuliers résultats que produisent ici le mélange des races et notre état social et religieux. Fils d'un Ecossais protestant et d'une mère française et catholique, M. Dunn, après la mort de son père, fut convoité et disputé par ses deux familles, et l'on peut dire par les deux races et les deux religions, et cela même devant les tribunaux. Il s'attacha à la langue et à la religion de sa mère, qui avaient été victorieuses dans cette lutte, et cela tout en conservant d'excellents rapports avec sa famille paternelle.

Cet amour de la langue française fut encore accru par sa résidence à Paris, où, après s'être distingué à la rédaction du *Courrier de Saint-Hyacinthe* dans notre pays, il fut attaché à celle du *Journal de Paris.*

La *Minerve*, l'*Opinion Publique*, la *Revue Canadienne* ont été successivement rédigées par lui à son retour, et dans son livre très remarquable, intitulé : *Dix ans de journalisme*, il a réuni les articles les plus sérieux et aussi les plus brillants de cette carrière de polémiste et de publiciste.

Un patriotisme exempt de toute exagération et de toute vulgarité, un cachet d'élégance naturelle et facile, distinguent tout ce qui est sorti de sa plume.

Ce demi-Ecossais, devenu plus français que les Français eux-mêmes, en vint à écrire une brochure sous ce titre : *Pourquoi nous sommes restés français*, brochure qui produisit quelque sensation lorsqu'elle fut exposée dans les vitrines des libraires de Paris. Le contraste du titre avec le nom de l'auteur était assez piquant, et les anciens collaborateurs de M. Dunn au *Journal de Paris* eurent peut-être seuls le mot de l'énigme.

J'ai déjà fait remarquer que nous avions dans la personne d'un de nos collègues de la section de la littérature anglaise la contre-partie vivante de M. Dunn : M. John Lespérance, né d'un père français et d'une mère anglo-américaine. Par une assez singulière coïncidence, M. Lespérance était rédacteur du *Canadian Illustrated News* en même temps que M. Dunn rédigeait l'*Opinion Publique Illustrée*—les deux entreprises n'en formant qu'une ;—et M. Dunn m'a raconté qu'un jour il aurait dit à son

collègue: "Maintenant ce serait à vous de publier une brochure sous ce titre: *Why it is that we remain English.*"

Il y a deux ans, lorsque M. Lespérance lut devant la section de la littérature anglaise un travail bien remarquable sur la littérature franco-canadienne, j'invitai M. Oscar Dunn à faire une étude du même genre sur la littérature anglo-canadienne et à la lire devant la section des lettres françaises.

Malheureusement des circonstances impérieuses ont empêché notre regretté confrère d'assister à nos séances, et de contribuer à la publication de nos Mémoires. Il se le reprochait, et il avait entre pris pour cette session un travail auquel il se livrait avec ardeur et que sa mort est venu interrompre.

Il en a été ainsi de la seconde édition de son *Glossaire franco-canadien*, auquel il consacrait une grande partie de son temps depuis plusieurs années. Nos collègues apprendront avec plaisir que M. Faucher de Saint-Maurice s'est chargé de surveiller ce qui reste à faire de l'impression. Ce Glossaire est une œuvre importante et qui n'aurait pas été indigne des efforts réunis de tous les membres de la première section.

Un éloge plus complet de notre regretté confrère, une étude de ses œuvres seront probablement la tâche de celui qui lui succédera; je ne puis qu'indiquer ici les traits principaux de son talent et de son caractère.

Il y avait en lui un polémiste, un chercheur et un bibliophile. Le polémiste nous a donné: *Dix ans de journalisme*, le chercheur a fait le travail du Glossaire, et le bibliophile avait déjà ramassé une très curieuse bibliothèque, que le *res angusta domi* l'a forcé à disperser en partie de son vivant, et dont les restes vont être vendus bientôt.

Partagé entre ces goûts et ces penchants, entre les diverses carrières de la politique, de la jurisprudence et de l'administration, auxquelles il se livra successivement, M. Dunn était surtout dévoué au culte de sa langue maternelle. C'était sa passion dominante et le secret de toute l'ardeur qu'il avait mise à cette étude, nouvelle chez nous, de notre langage populaire. L'amour de la langue française ne le cédait chez lui qu'à ses convictions religieuses, qu'à travers bien des dangers il avait su conserver intactes.

M. le vice-président a appuyé sur l'importance des études philologiques comparées, et sur l'intérêt qu'offrent d'un côté les vieilles langues indigènes qui vont disparaître, et les modifications qu'ont pu subir sur ce continent les idiomes européens qui s'y sont établis victorieusement en leur place.

M. Dunn a planté un premier jalon dans une de ces voies nouvelles, et son œuvre a été appréciée en Europe et ici comme elle le méritait. On me permettra peut-être d'ajouter que la fille de notre souveraine avait fait de ce petit livre une espèce de *vade mecum*, et l'emportait avec elle dans ses pérégrinations à travers nos campagnes.

Les goûts, les inclinations, les travaux de notre regretté confrère avaient marqué d'avance sa place dans notre Société; il y laisse un vide considérable qu'augmente encore pour tous ceux qui l'ont connu intimement le souvenir de son amabilité, de sa conversation instructive et spirituelle, de toutes les brillantes et estimables qualités de son cœur et de son esprit.

Que déjà trois vacances se soient faites dans cette Société depuis le peu de temps qu'elle existe, c'est un avertissement qui doit engager chacun de nous à bien employer le temps qui lui reste pour le succès de notre grande entreprise.

Jusqu'ici il n'y a pas eu de ralentissement dans l'impulsion que notre bienveillant et noble fondateur le marquis de Lorne a imprimé à notre mouvement littéraire et scientifique, et je n'ai nul doute que, sous la protection éclairée de son digne successeur, le marquis de Lansdowne, ce mouvement ne se propage avec une rapidité continue.

Mais en mettant les choses au pire, et en supposant que notre Société éprouvât quelques hésitations ou même quelques défaillances, il ne faudrait point nous décourager pour tout cela. Nous devrons nous dire que toutes les choses humaines ont ainsi quelques oscillations dans leur marche et dans leur progrès, et qu'il suffit qu'une institution ait sa raison d'être et soit conforme au génie du peuple chez qui elle s'est implantée pour qu'elle dure et fasse vie longue et prospère.

Or nul ne saurait douter qu'il en doive être ainsi d'une institution qui a été calquée sur celles qui

existent depuis longtemps dans les deux grands pays d'où les populations canadiennes tirent leur origine.

C'est le vœu de tous, et c'est chez moi une conviction profonde et qui n'est égalée que par la reconnaissance que je vous dois pour l'honneur que vous venez de me faire.

Speech by the Governor-General.

A vote of thanks to His Excellency for his attendance at the meeting was then moved by the President, Dr. T. Sterry Hunt, seconded by the Vice-President, Dr. Wilson, and carried unanimously amidst applause.

In reply, His Excellency spoke as follows:—

I thank you for the vote of thanks which you have been good enough to pass. If I have earned it, I have, I think, done so by maintaining a decorous silence during the progress of the proceedings—a silence which I should probably be wise in continuing, if I wished to keep you under the same sense of obligation towards me. I should, however, be sorry not to have an opportunity of saying, how glad I am to find that the Royal Society is prosperous and full of energy, and of assuring you that personally it is a source of satisfaction to me to be associated, even in an honorary capacity, with so distinguished a body. If I overstep these limits and attempt to say more, I shall find myself upon ground on to which I prefer not to venture. I confessed to you last year that I had no claims to a place, however lowly, in the ranks of either the representatives of literature or of science. The utmost for which I could hope would be that, from contact with you, I might obtain a superficial coating either of the one or the other. We all know that in Nature there is a tendency in plants and in animals, and even, if a distinguished member of the Society is to be believed, in inorganic substances, to mimic the forms by which they are surrounded, and to assume shapes and colours closely resembling those of their environment. In this way I can just now conceive that, after a time, I might be able to develop a spurious and superficial appearance of literary and scientific culture. You would, however, I am afraid, soon find me out; and you would not be long in discovering that, if I may use a geological simile which will perhaps pass current in the Ottawa district, what I had to present to you was pyroxene and not good, honest phosphate.

On the other hand, sir, I am only too ready to admit that we, whose lot is cast in political life, should be greatly the gainers if we were more directly under the influence of letters and of science. I am afraid it is too often the case that our literary tendency, if we have one, is not exhibited in any form more highly developed than that of a pungent epigram or a personal diatribe, and that our scientific investigations do not as a rule extend beyond researches into the prehistoric strata of "Hansard." How much better it would be for us and for our clients if our facts were more carefully verified and collected, more methodically arranged, and our inductions formed with more strict reference to the facts? Are we not all of us too fond of the most unscientific, or, in other words, of the most illogical forms of reasoning? Unhappily, too many of us belong to the great band of followers and partizans, who generally do not get very far beyond the kind of reasoning which consists in the assertion, that such and such statement must be true because such and such a person has made it, or perhaps, conversely, that such and such a person has made the statement, and that therefore it cannot be true? Again, do we not—those of us who would wish to be classed among the leaders and not the followers, and who think that we are fit to be entrusted with the direction of public affairs and the guidance of public opinion — often content ourselves merely with ascertaining that opinion, and assuming that when once it has been ascertained it must be right. We are, I am afraid, content with such methods as these and apt to banish political science first to our remotest book-shelves and then to the most distant planets.

And if we owe a debt to science, and if we ought to owe it a still greater one, we are surely no less in the debt of literature and no less blamable if we neglect her. In the age through

which we are passing, the volume of our public discussion is so immense, and the amount of public speaking expected of statesmen so enormous, that it is almost silly to hope for speeches modelled and polished like those of the great orators of earlier generations; and yet how immense is the superiority of those public men who, in addressing public audiences, are able to bring to the illustration of their subject something of real literary power and knowledge. Can we, for instance, believe that Mr. Gladstone would be able to produce those marvellous effects upon British audiences without that literary culture which, if his career had been a non-political one, would undoubtedly have won for him a high place amongst the men of letters of the century? Lord Salisbury is another example of a public man who has wielded the pen with success, and who owes a great deal to his literary training. Nor can any one read the admirable speeches which have been delivered from time to time upon political subjects by the distinguished man who has for some years represented the great American republic in England, — I mean Mr. Lowell—without feeling how much there is in the culture of the scholar and the poet from which the performances of the politician might derive dignity and wisdom and gracefulness. I think, therefore, gentlemen, that although the Royal Society is, fortunately for itself, entirely dissociated from politics, those who follow politics should be the first to recognize that there should be no divorce between political life on the one hand and literary and scientific life on the other, but that the former stands in need of and owes a debt to the latter.

With reference to the work of the Royal Society, I have only to say that it appears to me that the volume of Proceedings which has been placed in our hands contains a large amount of solid and creditable work. There are two subjects, the papers upon which strike me as being both numerous and good in quality. The first of these subjects is the ethnology of our native races. I dwell upon this, because the subject is one not only of great importance and interest, but one which demands the earliest possible attention. There can, I fear, be no question that—partly owing to the diminution in the number of those races, partly owing to the change in their mode of life and their gradual adoption of European manners and customs—the materials for ethnological study are every year becoming scarcer and more difficult to distinguish. This was, as you will remember, a matter which was pressed upon our consideration by the committee of the British Association shortly after their visit to Canada. The other subject is that of historical criticism bearing upon the history of our own country. There can, I think, be no class of investigation to which Canadian research can be more profitably directed than that of matters concerning the history of the country itself. I am glad to see that, in Section I, there are no less than ten excellent papers of this class. As to the future work of the Society, I would beg permission to say that I have listened with great pleasure to the words which fell from your President in regard to the study of the science of forestry. It is a relief to me to hear forestry spoken of as a science, because I am afraid we are too apt to forget what a very scientific matter forestry is. I am afraid that, in this country, we have been rather inclined to deal with our forests in a somewhat unscientific fashion. I do not mean to say that nothing has been done, because I have had the opportunity of looking into what has been written on the subject, and I am the first to recognize the value of information such as that contained in the writings of Mr. Phipp, Mr. Joly and Mr. Russell, of this city, whose excellent Report has been printed as a blue-book and presented to the English House of Commons. But I am satisfied that, the more we look into the subject of forestry, the more we shall find that, whether you regard the forests of this country as a valuable source of national revenue, or in reference to the results which will be occasioned to the climate of the country from their denudation which has been so rapidly progressing of late, you will find that the matter is one deserving of the most earnest investigation.

I have only to add, before I sit down, an expression of my concurrence in all that has been said by the President with regard to the visit of the British Association. The results of that visit will be far-reaching and most valuable to this country, both in adding to the fund of accurate and scientific knowledge with regard to the Dominion and its resources, and in establishing more intimate relations between the men of science and letters of the Dominion and those of the Old World.

SESSION III. (*May 27th.*)

The Royal Society again assembled at 10.30 o'clock on Wednesday morning, in the Railway Committee Room, with the President, Dr. T. Sterry Hunt, in the chair.

REPORTS FROM AFFILIATED SOCIETIES. (*Continued.*)

The reports of delegates from affiliated societies were continued as follows:—

VI. From the Natural History Society of New Brunswick, through MR. W. F. BEST:—

As delegate from the Natural History Society of New Brunswick to the Royal Society of Canada, I have to report that the New Brunswick Society has made considerable advance during the past year. Our membership is larger than ever before, our finances are in a healthy condition—being assisted by a grant from the Local Legislature,—and, as you will notice when I read a list of the papers prepared during the year, the members of the Society have done a great deal of valuable work. The library and collections of the Society have received many important additions during the year, both by donation and purchase.

The city of St. John—the headquarters of our Society—not being a University town, has not the facilities for systematic scientific work which are to be found in connexion with the higher educational institutions. In consequence of this, our Society finds itself obliged to become, to a certain extent, a teaching institution. We have been obliged to gather together books to form a Natural History Library, and collections of rocks, minerals, fossils, birds, animals, insects, etc.; and in addition to all this we have found it necessary to undertake courses of elementary science teaching, in order to train up a new generation of workers in various departments of scientific investigation. In addition to this a Field Club has been organized, which will no doubt do valuable work in the departments of botany, geology, entomology, etc.

The chief drawback to the progress of the Society in the past has been, that there was only a limited number of active workers. It affords me much pleasure to state that several interesting papers have been contributed during the past year by gentlemen who had not previously taken an active part in the work of our Society.

Last summer our annual "camp" was established at Bocabec, on Passamaquoddy Bay, and many valuable opportunities were afforded for the study of marine life as well as for that of the geology and botany of the region. In addition to this, a collection of stone weapons, implements, etc., with pottery and other relics of the Stone Age, was made and subsequently placed in the cabinets of our Society. Our valuable geological collections are now being placed in properly constructed cases, and the insects and birds belonging to the Society have also been arranged in glass cases.

We now consider it desirable that the rooms of the Society should be open to the public on certain days of each week, and arrangements are being made with this in view. A free class in Elementary Chemistry, held in the rooms of the Society during the winter, was attended by a large number of enthusiastic students, and the unexpected success of this effort will no doubt induce specialists in other departments of scientific work to undertake similar courses of lectures next winter.

The original papers read before our Society during the year 1884–5 were as follows:—

Feb. 5, Discoveries at a Village of the Stone Age at Bocabec, by G. F. Matthew, M.A.
Mar. 4, The International Fisheries Exhibition, by Wm. M. McLean.
April 1, Gulls, by Fred W. Daniel.
A Lacustrine Deposit at Fredericton, by W. T. L. Reed.
May 6, The Geology of the Grand Falls, by R. Chalmers.
June 3, Rhizopods, by L. C. Allison, M.D.
Sept. 2, The Invertebrate Zoology of Passamaquoddy Bay, by W. F. Ganong.

Oct. 7, Botanical Notes on the Upper St. John, by G. U. Hay.
Some Differences between Animals and Plants, by Prof. James Fowler.
Nov. 4, Corvidæ, by Alfred Morrissey.
Cormorants, by Fred. W. Daniel.
Migration of Birds, by M. Chamberlain.
Dec. 2, Fossils of the Cambrian Rocks at St. John, by G. F. Matthew, M.A.
Jan. 6, The Food Fishes of New Brunswick, by W. M. McLean.

Besides the above there were five free lectures on Elementary Science, as follows:—

Feb. 19, The Atmosphere, by W. F. Best.
Mar. 18, 25, The Anatomy and Physiology of Digestion, by W. F. Coleman, M.D.
April 15, Winter Birds, by M. Chamberlain.
May 20, The Fertilization of Plants, by G. U. Hay.
Dec. 16, Public Hygiene, by L. C. Allison, M.D.

VII. From la Société Historique de Montréal, through Abbé Verreau:—

La Société Historique de Montréal a l'honneur de porter à la connaissance de la Société Royale du Canada:—

1o Que dans le cours de l'année qui vient de s'écouler depuis le mois de mai dernier, elle a admis six nouveaux membres actifs;

2o Qu'elle a vu sa bibliothèque s'augmenter de près de trois cents volumes, brochures et documents parlementaires;

3o Qu'elle a commencé l'impression du livre d'ordres du baron de Dieskau, et qu'elle espère le livrer au public dans le cours du mois de juillet;

4o Qu'elle a continué à faire copier des documents manuscrits, autant que ses faibles ressources le lui ont permis;

5o Qu'elle renouvelle le vœu, souvent exprimé, de voir la Société Royale recommander au gouvernement fédéral la publication du *Dictionnaire Généalogique* de M. l'abbé Tanguay, comme œuvre historique de la plus haute importance.

VIII. From the Numismatic and Antiquarian Society of Montreal, through Mr. R. W. McLachlan:—

On behalf of this Society I have the honour to report the following original papers read during the past year:—

1. The History of Canadian Money, by R. W. McLachlan.
2. Old Montreal, by Henry Mott.
3. The Heraldic History of Canadian Towns, illustrated by sketches and examples, by J. H. Bowe.
4. Antiquities of the Island of Orleans, by R. C. Lyman.
5. The First Montreal Directory, by Henry Mott.
6. Le Chevalier de Levis, by the Hon. P. J. O. Chauveau, LL.D.

Nine meetings have been held during the year, at which many points relating to Canadian Numismatics and Antiquarian history have been taken up and discussed.

During the coming year the work of cataloguing and describing the coins and medals bearing on Canadian history, undertaken by a member of the Society, will be completed and ready for issue to the public.

The issue of the *Canadian Antiquarian*, which had been suspended for a year, has been resumed, and I have the pleasure to lay before you the first number of the eleventh volume. In this quarterly have appeared the Proceedings and Transactions of the Society and many original papers, elucidating difficult points in our history and describing new and rare numismatic mementoes.

Thanking the Royal Society of Canada for this further opportunity of making its proceedings public, the Numismatic and Antiquarian Society of Montreal has much pleasure in submitting the above Report.

IX. From the Natural History Society of Montreal, through Dr. J. Baker Edwards :—

I have the honour to report on behalf of the Natural History Society of Montreal that the Society (incorporated in 1832), completed its fifty-third session on the 18th instant, under the Presidency of Dr. T. Sterry Hunt, who has held the chair for the past two years and is now succeeded by Sir William Dawson. During the past year, His Excellency the Governor-General has kindly consented to become the Patron of this Society. The Society has added to its numbers ten ordinary members, one life member, and one corresponding member—making the roll of the Society over 200 members.

The usual grant has been awarded by the Quebec Legislature, and many valuable additions have been made to the Society's Museum, among which may be mentioned specimens of the Gopher, the Turkey Buzzard, White Pelican, Night Heron, American Badger, etc., obtained and presented by Mr. William Muir from the Northwest; also interesting fossil remains from borings for the Panama Canal, presented by Dr. Wolfred Nelson of Panama, and a collection of fossils, recent shells, and Indian curiosities from Central America, from Dr. Wolfred and Mr. George Nelson; also a very handsome case of British Game Birds, presented by Mr. Albert A. Jowett, of Sheffield, England. A handsome donation has also been made to the Society by a few of its active members, viz., a fine portrait, by Mr. Bell Smith, of the late Sir W. E. Logan, which is placed in the Society's library.

Valuable exchanges have also been added to the library, and the Society regrets that, from unavoidable circumstances, the publication of their journal the *Canadian Record of Science*, has been unduly delayed, but trusts that its issue will shortly be completed and punctual.

The usual number of monthly meetings have been held, and the following original papers contributed :—

1. The Scientific Aspects of the British Association in Montreal, by the President, Dr. T. Sterry Hunt.
2. The Geology of the Nile Valley, by Sir William Dawson.
3. The Habits of the Animals and Birds from the Northwest recently added to the Museum, by by Dr. O. C. Edwards.
4. On the Sanitary Disposal of Sewage by Cremation, by Dr. J. Baker Edwards.
5. On the Ring Growth of Exogens in Relation to the Age of Trees, by Prof. D. P. Penhallow.
6. On the Canadian Diptera, their Habits and Development, by F. W. Caulfield.
7. On the Organic Remains in Fresh-water Lakes of Nova Scotia, by A. H. MacKay.
8. On the Infusorial Deposits in Nova Scotia and New Brunswick, and their Utilization, by Mr. A. Mackenzie.
9. On the Cambrian Rocks of St. John, New Brunswick, by G. F. Matthew.
10. On the Work of the Exploration Fund in Egypt, by Sir William Dawson.
11. Chemical Notes, by Prof. J. T. Donald.

Seven public free lectures have been delivered in the annual Sommerville Course, which have been numerously attended and well received. On these occasions the Museum of the Society has been thrown open to the public, and a large number of persons, estimated at over 2,000, have availed themselves of the privilege of visiting it.

The lectures were as follows :—

Feb. 12. The British Association at Montreal, by Dr. T. Sterry Hunt.
Feb. 19. Reminiscences of the late Sir W. E. Logan, by Dr. Robert Bell.
Feb. 26. Certain Features of our Climate, by Dr. W. H. Hingston.

March 5. Phenomena of Plant Growth, by Prof. D. P. Penhallow.
March 12. Cholera, by Dr. J. B. McConnell.
March 19. Time-Observing and Time-Keeping, by Prof. C. H. McLeod.
March 26. The Valley of the Nile, by Sir William Dawson.

X. From the Murchison Scientific Society, Belleville, through Mr. W. R. Smith:—

In presenting this Report of the Murchison Scientific Society of Belleville, being the first which has been read before your Royal Society, I beg to give the following information as to its present position and standing. The Society was formed in June, 1873, as the Murchison Club, with the object of promoting research and of making known the general natural history and characteristic productions of the district, as well as of promoting scientific knowledge by reading papers and communications, etc. It was carried on under this name with varying success until 1882, when it was reorganized with the same aim and objects as the Murchison Scientific Society. A number of papers had been read during that time, some of them of considerable interest; but, owing to the smallness of the membership (about thirty) and the want of funds for the purpose, no transactions or papers were printed. After having agitated the question for several years, it was decided in 1883 that an effort should be made to form a museum in connection with the Society. The authorities of Albert College, Belleville, on hearing our decision, offered to provide us with the room and to place their collection with ours. As their collection contained a good display of minerals and a large number of casts of leading types of fossils from different formations, this offer was accepted, and we have since carried on the museum with the utmost harmony and success. Our attention has been turned since then principally in the direction of obtaining specimens of the living fauna of the locality, and during the last two years we have placed over sixty species of birds and ten of mammals, stuffed and mounted, in the museum, besides representatives of other orders. A good representation of the characteristic fossils of the Trenton formation of the neighbourhood has been made, some of them very rare. We have also a fine display of the woods grown in the locality, numbering some fifty species, cut so as to show bark, quality and grain. As the County of Hastings contains large deposits of iron and other ores, specimens of all the mines that can be obtained have been placed on exhibition, so that a good idea can now be formed of the greatness and extent of our mineral wealth, which, gentlemen, I can assure you, will in the future be of the utmost importance, not only to our own county but to the country at large. Although our Society is small, it proves, as the preceding facts will show, that we have not been idle, considering that we have not had any municipal or other grant of any kind to assist us. The officers for the present year are:—

President...Thomas Wills.
Vice-President..Dr. H. James.
Treasurer..Jas. Marsden.
Secretary..W. R. Smith.

XI. Dr. Ellis, on behalf of the Canadian Institute, made a brief statement showing the work of that association during the past year.

XII. In the absence of Mons. H. J. J. B. Chouinard, the following Report of the Geographical Society of Quebec was received:—

Depuis le mois de mai de l'année dernière (1884), la Société de Géographie de Québec a continué à travailler dans la mesure de ses forces à faire connaître la géographie physique de la province de Québec en particulier, en prenant pour objet de ses études les terres peu connues situées au nord de cette province, dans la direction du Mistassini et de la Baie d'Hudson.

Une exploration aux frais communs du gouvernement fédéral et du gouvernement de Québec se poursuit actuellement dans la région du lac Mistassini, et notre prochain annuaire, maintenant en préparation, contiendra des renseignements nouveaux et importants sur ce sujet.

Nous formons des vœux pour que nos gouvernements continuent cette exploration sans perdre de vue la partie géographique, si importante pour la colonisation.

Dans le cours de l'année qui vient de s'écouler, notre société s'est maintenue dans un état de prospérité remarquable. Notre annuaire prochain contiendra plusieurs travaux scientifiques qui n'ont pas été lus en public sous forme de conférences comme les années précédentes, mais qui ne manqueront pas d'intéresser les savants.

Notre société s'est efforcé de recruter de nouveaux membres, et a réussi à conserver les anciens. L'état financier est satisfaisant, vu les circonstances; mais notre société ressent vivement les effets de la suspension des crédits que lui ont votés par le passé les gouvernements d'Ottawa et de Québec.

Nous avons été heureux d'apprendre que la Société Royale de Géographie d'Angleterre a choisi cette année pour son président, le marquis de Lorne, ancien gouverneur du Canada. Les sympathies que cet homme distingué a montrées envers notre société nous font espérer que sa promotion à cette charge nous facilitera les relations qui nous unissent déjà aux sociétés géographiques de l'Europe.

Vous trouverez ci-jointe la liste de notre bureau pour l'année courante:—

Président	H. J. J. B. Chouinard.
Vice-présidents	Charles Baillairgé. Vincent Cazeau. Le colonel Rhodes.
Sec.-cor. français	N. Levasseur.
Ass. " "	Jos. Chouinard.
Sec.-cor. anglais	W. C. Seaton.
Ass. " "	F. H. Bignell.
Secrétaire-archiviste	F. D. Tims.
Ass. " "	W. D. Baillairgé.
Bibliothécaire	E. T. Fletcher.
Trésorier	A. H. Furniss.
Membres du conseil	T. Ledroit, le lieut.-col. Vohl, le Dr Venner, E. LeMoine, J. F. Guay.

XIII. From the Ottawa Literary and Scientific Society, through Mr. Wm. P. Anderson:—

During the year which has elapsed since I had the honour of submitting its last report, the Literary and Scientific Society of Ottawa has continued its work with a fair measure of prosperity, in the directions which experience has shown to be most successful, and as a prosperous career is usually an uneventful one there is little of interest to report this year.

At the Annual General Meeting held last month the following Officers were elected for the current year:—

President	Wm. P. Anderson.
First Vice-President	J. P. Featherston.
Second Vice-President	D. Matheson.
Secretary	G. M. Greene.
Treasurer	J. R. Armstrong.
Librarian	F. K. Bennetts.
Curator	A. Magill.
Members of Council	Wm. D. LeSueur. Paul T. Lafleur. W. Scott.

The number of members on our roll still continues about the same (350), and the reading room and library have been more used than in any previous years,—the capacity of the reading room being often so taxed as to suggest the desirability of a further enlargement of quarters. Some periodicals have been added to the reading room, while 214 new books have been bought or presented to the library, and the purchase of some additional popular works has been lately authorized.

The Society has found it unnecessary to continue any longer its classes of instruction, especially as classes in art and design are now conducted by the better equipped and admirably managed Ottawa Art School.

The usual course of winter lectures was held, and proved most successful. The Society deems itself specially fortunate in having been favored by an eloquent address by the first President of your Society, Sir William Dawson.

One feature in the course, that of introducing a number of short papers on the same evening, was very popular, and seems calculated to bring to light and develop the literary abilities of our individual members, who might be unwilling to venture at first on more extended essays. For this reason our Society would recommend a trial of this system by other similar Societies.

The following is a list of the lectures delivered and papers read during the past winter:—

1. Inaugural Address on the Elements of Culture, by the President, Wm. D. LeSueur.
2. Lecture on Methods of Illumination, with practical illustrations, by Wm. P. Anderson.
3. Lecture on the Principles of Symmetry in Nature, by A. Magill.
4. Lecture on the Geology of the Nile Valley, by Sir William Dawson.
5. Lecture on John Milton, by the Rev. W. T. Herridge.
6. Lecture on Latest Advices, by the Rev. Principal S. S. Nelles.
7. Address on the Value of the Study of Entomology, by James Fletcher.
8. Essay on the Origin of Prairie Lands, by Dr. G. M. Dawson.
9. Essay on Mimicry in Nature, by W. H. Harrington.
10. Address on Charles Lamb and Tom Hood, by J. R. Armstrong.
11. Essay on the Modern School of Poetry, by A. Lampman.
12. Essay on the Iroquois in the Time of Champlain, by F. H. Gisborne.

Miscellaneous Business.

Dr. Johnson moved, seconded by Mr. Geo. Stewart, jun., "That that section of the Report which refers to certain gentlemen as having failed to attend for three years be adopted, and that their resignations be considered final."

Dr. Daniel Wilson moved, in amendment, seconded by Dr. Chauveau, "That the section of the Report in question be referred to a committee to communicate with the gentlemen named in the Report as assumed to have resigned, and to report to the Council on the subject with a view to establish a precedent on the future action of the Society, and that the said committee be composed of Dr. Chauveau, Sir William Dawson, Dr. Johnson and Dr. Wilson."

And the question being put on the amendment, it was agreed to, and the main motion amended accordingly.

On motion of Dr. Johnson, seconded by Mr. Bourinot, "It was agreed unanimously that M. N. Bourassa, Dr. Osler and Dr. J. Bernard Gilpin be permitted to retain their titles and be entered on the list of retired members, in accordance with the recommendation of the Report of the Council."

SESSION IV. (*May 28th.*)

The President took the chair at 10.30 o'clock, A.M.

Miscellaneous Business.

Rev. Æneas McD. Dawson moved, seconded by Abbé Tanguay, "That the votes of the Fellows of a Section in which an election is required, who are unavoidably absent from illness or any other cause, be counted, as well as the votes of such as can be present at the meeting at which the election must take place; that such absentee members be afforded full opportunity of giving their votes, and that it be left to the Council of the Royal Society to arrange and determine in what way the votes of necessarily absent Fellows shall be taken."

Dr. Johnson moved in amendment, seconded by Dr. Chauveau, "That the matter be referred to the Council with a request to report thereon to the Society next year."

And the question being put on the amendment, it was agreed to, and the main motion amended accordingly.

The following motions were agreed to:—

On motion of Dr. Chauveau, seconded by M. Marchand, "That the question of the augmentation of Corresponding Members be referred to the Council."

On motion of Sir William Dawson, seconded by Mr. Bourinot, "That the Council be requested to formulate a rule with regard to Amendments to the Constitution, and submit it to the Society at its next general meeting."

The meeting was then adjourned until the following day at 10 o'clock, A.M.

SESSION V. (*May 29th.*)

The President took the chair at 10 o'clock, A.M.

Miscellaneous Business.

Mr. T. C. Keefer made a brief report of the work performed by the Hamilton Association, and handed in a printed copy of its Transactions.

The Society then proceeded to the election of new Fellows.

The Honorary Secretary read the following communication from Section I, in accordance with Rule 6:—

Société Royale du Canada.
Ottawa, 28 mai 1885.

J. G. Bourinot, Esq.,
Secrétaire honoraire S. R. du Canada.

Monsieur,—

J'ai l'honneur de vous informer que la 1ère section de la Société Royale du Canada a nommé au siège laissé vacant par la mort de M. Oscar Dunn, M. Alfred Duclos-DeCelles, conservateur de la bibliothèque du parlement canadien. Les principaux titres de M. DeCelles à ce choix sont la haute valeur de cet écrivain comme journaliste, et les importants travaux littéraires et historiques qu'il a publiés dans diverses revues.

La section a également nommé au siège laissé vacant par la démission de M. Napoléon Bourassa,

M. Alphonse Lusignan, qui depuis longtemps s'est distingué comme journaliste et comme auteur de plusieurs études littéraires, entre autres d'un livre intitulé: *Coups d'œil et coups de plume.*

Vous voudrez bien communiquer cette information au Conseil de la Société.

Et obliger

Votre très humble, &c.,

L'ABBÉ CYPR. TANGUAY.

On the motion of Abbé Casgrain, seconded by Abbé Tanguay, the recommendation of Section I, just read, with respect to the election of Messieurs Lusignan and DeCelles as members of the Royal Society, was agreed to.

The Honorary Secretary next informed the Society that the Council had received a communication from Section IV, recommending the election of Mr. James Fletcher of Ottawa, Dr. Burgess of London, and Professor Penhallow of Montreal, as Fellows of the Royal Society, to fill vacancies in the foregoing section. The following recommendation of the same Section was also communicated with respect to the election of a new corresponding member, in accordance with the regulation passed in the session of May, 1884:—

On the motion of Sir William Dawson, seconded by Dr. T. Sterry Hunt, "*Resolved:* that Professor T. C. Bonney, D.Sc., LL.D., F.R.S., F.S.A., President of the Geological Society of London, Secretary of the British Association for the Advancement of Science, and author of several important works and memoirs on geology, be recommended for election as a Corresponding Member of the Royal Society of Canada. Dr. Bonney has also rendered important services to Canadian science in connection with the recent meeting of the British Association in Montreal."

The foregoing recommendations were unanimously agreed to.

REPORTS OF SECTIONS.

The President then called upon the respective Sections to report their Lists of Officers and the work in said Sections during the present meeting. The following reports were accordingly made:—

Rapport de la Section I.

La première section s'est réunie le mardi 26 mai 1885. Il y a eu douze membres présents aux séances.

Il a été décidé, le 27, que la section demanderait à la Société de faire mettre dans les deux langues de ce pays le titre des Mémoires imprimés de la Société, sur la couverture de ces Mémoires.

On a aussi lu les études et ouvrages suivants :

I. Une étude sur Vauquelain, par M. FAUCHER DE SAINT-MAURICE.
II. *Le premier parlement canadien,* par M. FAUCHER DE SAINT-MAURICE.
III. *De l'élément étranger aux Etats-Unis,* par M. FAUCHER DE SAINT-MAURICE.
IV. Une étude sur M. Gérin-Lajoie, par M. L'ABBÉ CASGRAIN.
V. Une nouvelle historique: *Le dernier boulet,* par M. MARMETTE.
VI. *La population blanche de la Nouvelle-France, de* 1608 *à* 1631, par M. L'ABBÉ TANGUAY.
VII. *A travers les registres du XVIIe siècle,* par M. L'ABBÉ TANGUAY.
VIII. *La race française en Amérique,* par M. LEGENDRE.
IX. *L'anatomie des mots,* par M. LEGENDRE.
X. Epître à M. Prendergast, après avoir lu *Un soir d'automne,* (poésie), par M. CHAUVEAU.
XI. *L'Angleterre et le clergé français,* par M. L'ABBÉ BOIS.
XII. *Autrefois et maintenant* (poésie), par M. LEGENDRE.
XIII. Une fable en vers: *L'aigle et la marmotte,* par M. MARCHAND.

XIV. Une épître en vers, par M. Marchand.
XV. *Les premières pages de notre histoire* (poème), par M. Fréchette.
XVI. *Lettre d'un volontaire* (poésie), par M. Routhier.
XVII. *Les derniers seront les premiers* (poésie), par M. Lemay.
XVIII. Une étude sur les racines de la langue algonquine, par M. l'abbé Cuoq.
XIX. Une étude sur certaines prétendues origines des Canadiens-français, par M. Sulte.

Le 28 mai, on procède aux élections pour remplacer deux membres. M. A. D. DeCelles remplace M. Dunn. M. Alphonse Lusignan remplace M. Bourassa, démissionnaire. Ces élections ont été faites au scrutin secret. Les candidats ont été proposés par des membres qui se sont constitués leurs parrains et ont répondu de leur acceptation.

Ensuite ont eu lieu les élections annuelles du bureau, avec le résultat suivant :

Benjamin Sulte, *président.*
Paul de Cazes, *vice-président.*
Alphonse Lusignan, *secrétaire.*

M. Lusignan a été désigné à l'unanimité comme devant être nommé secrétaire, dans le cas où son élection comme membre serait ratifiée par l'assemblée générale.

Le tout humblement soumis.

F. G. Marchand, *président.*
Benjamin Sulte, *secrétaire.*

Ottawa, 29 mai 1885.

Report of Section II.

I have the honour to report that Section II has elected as Office-bearers for the ensuing year:—

Lt.-Col. George T. Denison, B.A., *President.*
R. M. Bucke, M.D., *Vice-President.*
George Stewart, Jun., *Secretary.*

The Committee on Publications is composed of Rev. Dr. J. Clark Murray, John George Bourinot, and George Stewart, jun.

The same committee appointed last year to consider the paper read by Rev. Professor Geo. Bryce, of Winnipeg, a delegate to the Royal Society, in which the question of publishing memoirs or old books relating to Canadian history, travel, etc., under the auspices of the Royal Society is discussed, was re-appointed. The committee is composed of John George Bourinot, *Chairman;* John Reade, John Lesperance, and George Stewart, jun.

The following papers were read :—

I. The Annals of an Old Society. By John M. Harper, Ph. D.
II. The Artistic Faculty in American and other Primitive Races. By Dr. Daniel Wilson.
III. The Adventures of Isaac Jogues. By Rev. Dr. W. H. Withrow.
IV. The Five Forts of Winnipeg. By Rev. Prof. J. Bryce.
V. Richard the Second in Scotland. By Rev. Æneas McD. Dawson.
VI. Palæolithic Dexterity. By Dr. Daniel Wilson.
VII. Sources of Early Canadian History (presented). By George Stewart, Jun.
VIII. The Half-Breed (presented). By John Reade.
IX. Vita Sine Literis (presented). By John Reade.

I have the honour to be, Sir,
Your obedient servant,
George Stewart, Jun., *Secretary.*

Report of Section III.

The number of members of the Section in attendance was twelve. Of the absent members, Mr. Baillairgé, and Professors Cherriman and McGregor forwarded papers to be read. The other absent members were Capt. E. Deville, Professor N. F. Dupuis, Mr. Sandford Fleming, Mr. F. W. Gisborne, and Professor Harrington.

The Officers elected for the ensuing year were:—

Mr. C. Carpmael, *President.*
Mr. T. Macfarlane, *Vice-President.*
Mr. G. C. Hoffmann, *Secretary.*

The accompanying list gives the title of the papers read in full or in abstract, or accepted as read:—

I. Presidential Address. By Dr. A. Johnson.
II. On a Natural System in Mineralogy with a Classification of Silicates. By Dr. T. Sterry Hunt.
III. Blowpipe Reactions on Plaster Tablets. By Dr. E. Haanel.
IV. On the Quantitative Blowpipe Assay of Cinnabar. By Dr. E. Haanel.
V. The following by Prof. J. P. Loudon:—
1. Clausius' Theory of the Virial.
2. The Motion of a Rigid Body with One Point Fixed.
3. The Equation of Energy on Generalized Coordinates.
4. Geometrical Methods in Optics.
VI. On the Longitude of Toronto. By Mr. C. Carpmael and Prof. McLeod.
VII. Communicated by Dr. A. Johnson:—
1. On the Longitude of the Transit Instrument at the Observatory, McGill College, Montreal. By Prof. W. A. Rogers, of Harvard, Mass., and Prof. McLeod, of McGill College, Montreal.
2. On the Longitude of Cobourg. By Prof. McLeod and Mr. Chandler.
VIII. On Tidal Observations in Canadian Waters. By Dr. A. Johnson.
IX. On the Analysis of Silk. By Dr. H. A. Bayne.
X. On the Geognosy of Crystalline Rocks. By Dr. T. Sterry Hunt.
XI. On the Determination in Terms of a Definite Integral, etc. By Mr. C. Carpmael.
XII. Verbal account by V. Rev. T. E. Hamel of a paper by Dr. D. Duval, entitled: "Mémoire sur l'introduction et l'interprétation rationelle des quantités négatives et des quantités imaginaires dans le calcul."
XIII. On some Iron Ores of Central Ontario. By Prof. E. J. Chapman.
XIV. Concernant la théorie de M. Steckel sur la veine liquide contractée. By M. C. Baillairgé.
XV. The Density of Weak Aqueous Solutions of certain Salts. By Prof. J. C. MacGregor.
XVI. A Commentary on Section IX of Newton's Principia. By Prof. J. B. Cherriman.

Alexander Johnson, *President.*
G. C. Hoffmann, *Acting-Secretary.*

Report of Section IV.

The papers whose titles and authors are enumerated below were read either *in extenso* or by title:—

I. On a new Mesozoic Flora discovered by Dr. G. M. Dawson in the Rocky Mountains. By Sir William Dawson, LL.D., F.R.S.

II. Illustrations of the Fauna of the St. John Group. No. 3. By G. F. Matthew, M.A.

III. Geology of Cornwallis or McNab's Island, Halifax Harbour. By Rev. Prof. Honeyman, D.C.L.

IV. Notes on the Economic Minerals of New Brunswick, with a revised list of mineral localities in the Province. By Prof. L. W. Bailey, M.A., Ph. D.

V. On the Geology of South-eastern Quebec. By Thomas Macfarlane, M.E.

VI. On the Geology of Thunder Cape, Lake Superior. By Thomas Macfarlane, M.E.

VII. On the Wallbridge Hematite Mine, as illustrating the Mode of Occurrence of certain Ore-deposits. By Prof. E. J. Chapman, Ph. D., LL.D.

VIII. A Catalogue of Canadian Butterflies, with notes on the Distribution of the Genera. By W. Saunders.

IX. On Fossil Plants from the Trias and Permian of Prince Edward Island, collected by Mr. Francis Bain. By Sir William Dawson, LL.D., F.R.S.

X. Cambrian Rocks in the Rocky Mountains. By G. M. Dawson, D. Sc., A.R.S.M., F.G.S.

XI. Note on the Siluroid Genus, *Hypophthalmus*. By Prof. R. Ramsay Wright, M.A., B. Sc.

The election of Officers of the Section for the ensuing session resulted as follows:—

Principal Sir William Dawson, LL.D., F.R.S., *President.*
Rev. Prof. J. C. K. Laflamme, D.D., *Vice-President.*
J. F. Whiteaves, F.G.S., *Secretary.*

The following gentleman were nominated for the three vacancies in the Section, the names being given in the order of the number of votes received by each:—

1. Mr. James Fletcher, of the Parliamentary Library, Ottawa.
2. Prof. D. P. Penhallow, B. Sc., of McGill University, Montreal.
3. Dr. Thomas Burgess, of London, Ontario.

The Section recommend that Professor R. G. Bonney, LL.D., F.R.S., Secretary to the British Association for the Advancement of Science and, at present, President of the Geological Society of London, be elected a corresponding member of the Society.

J. F. Whiteaves, *Secretary.*

Election of Officers.

The Society then proceeded to the Election of Officers for the ensuing year, and the following were unanimously chosen:—

President.—Dr. Daniel Wilson. (On the motion of Dr. Chauveau, seconded by Mr. George Stewart, jun.)

Vice-President.—Very Reverend Rector Hamel. (On the motion of Sir William Dawson, seconded by Dr. Johnson.)

Honorary Secretary.—Mr. John George Bourinot. (On the motion of Mr. George Stewart, jun., seconded by Dr. Johnson.)

Honorary Treasurer.—Dr. Grant. (On the motion of Abbé Casgrain, seconded by Dr. Fréchette.)

Concluding Resolutions.

The following Resolutions were proposed and adopted:—

1. That the Council be instructed to supply hereafter only one copy of the Transactions to the Fellows of the Society, but at the same time to give them the privilege of obtaining three additional copies at cost price. (On the motion of Mr. T. Macfarlane, seconded by Mr. Carpmael.)

2. That a statement be submitted annually to the Society of the number of copies of each volume of the Transactions held by the Society. (On the motion of Mr. Carpmael, seconded by Mr. Stewart.)

3. That Dr. B. J. Harrington, Dr. MacGregor, Professor Laflamme, Dr. Clarke Murray, M. Hector Fabre, and such other members as may be in Europe, be appointed Delegates to represent the Royal Society at the meeting of the Association française at Grenoble, in August next. (On the motion of Dr. Johnson, seconded by Dr. Chauveau.)

4. That the thanks of the Society be given to the Speakers of the Senate, and of the House of Commons, for the accommodation afforded the members during the present meeting. (On the motion of Sir William Dawson, seconded by Dr. Chauveau.)

5. That the best thanks of the Society be tendered to the retiring President for his earnest efforts in behalf of the Society. (On the motion of Sir William Dawson, seconded by Dr. Chauveau.)

The Society then adjourned until May, 1886.

ROYAL SOCIETY OF CANADA.

APPENDIX TO PROCEEDINGS FOR 1885.

(See page vi.)

Report of the Committee of the Royal Society of Canada consisting of PROFESSORS JOHNSON, MACGREGOR *and* CHERRIMAN, DR. HUNT *and* M. SULTE, *on the Encouragement of Original Literary and Scientific Work.*

Your Committee were appointed on May 25th, 1883, and instructed " to inquire into, and report upon the forms of Aid and Encouragement given in other countries to young men deemed qualified and desirous to engage in Original Literary or Scientific Work, and to suggest the best means of providing similar aid and encouragement for young men in Canada." In consequence, partly, of the death of Dr. Todd, who had undertaken to assist in gathering together the necessary information, we were unable to make a report at the last meeting of the Society. We were, therefore, re-appointed with the original instructions. In carrying out your instructions, we have restricted our enquiries to the United Kingdom and her Colonies and the United States.

We have considered it unnecessary to report upon the educational facilities provided by Universities for advanced study of literary and scientific subjects, such as lectures, libraries, museums and laboratories. An account of such facilities, as offered in various countries, would fill volumes, and we may safely assume that not only all the Fellows of the Society but also the educated public are already convinced of the necessity of giving our Universities the best possible equipment in these respects. We have, therefore, restricted our inquiry to the incomes provided by Universities and other corporations, in the form of Fellowships, Scholarships, Exhibitions, Bursaries, etc., to enable young men of promise to devote themselves for longer or shorter periods to the study of the higher branches of learning.

It has been found somewhat difficult to distinguish between incomes provided to assist students in pursuing a course of general education (usually called Scholarships, Exhibitions, etc.,) and those intended to enable them to pursue the study of special branches (often called Fellowships). We have considered incomes awarded to students for their support before the attainment of the academic rank of Bachelor as beyond the scope of our report, but those intended to assist them in pursuing their studies after their attainment of that rank, we have considered to be " forms of aid and encouragement " as to which information was to be sought. In cases in which Scholarships, etc., though awarded before graduation are tenable after graduation, we consider them to be " forms of aid " beginning at the date of graduation, and they are thus entered in the table given below.

It need hardly be said that we have included in the statement given below, only those Fellowships, etc., which are awarded on conditions permitting the holders of them to devote themselves to advanced study of a literary or scientific kind. We have, therefore, excluded purely professional Fellowships. There are, however, cases in which the pursuit of some branch of what is ordinarily considered Professional study is permitted, as for instance Hebrew or Physiology, which we have considered to come within the scope of our report.

The information which we have collected will be found, we hope, to be tolerably full and practically accurate, although there may, no doubt, be errors in it in spite of all precautions. Our object has been, not so much to give a minutely detailed account of encouragement offered by Universities to their graduates to engage in literary or scientific work, as to shew had much greater is the encouragement offered by means of Fellowships in other countries than in Canada.

With respect to the United Kingdom, we have relied upon the Calendars of Universities and

Colleges, and in cases in which these were not available, upon the excellent compendium of facts contained in Cassell & Co.'s Educational Year-Book. The Calendars of Oxford, Cambridge and Dublin Universities, in many cases, do not give the annual values of the numerous Fellowships provided by their Colleges or the sources whence their endowments have been derived. We have not considered it necessary to enquire into their values in detail. Probably for Oxford and Cambridge they may be taken in general at about $1,000 to $1,250 per annum. They have all been endowed mainly by private beneficence. The conditions of their tenure are different in different Colleges, and are undergoing change under recent Acts of Parliament, the tendency being to render the Fellowships more productive of literary and scientific results. In Dublin, the Fellowships, which are awarded by open competitive examination, correspond more nearly to what would be called Professorships in this country, and rise gradually by seniority to an average yearly value of about $7,000 to $8,000 as we have learned. With regard to the Scholarships of some of the Colleges of Oxford and Cambridge, it is impossible to ascertain from the Calendars for how many years they may be held. Such Scholarships we have not mentioned, though possibly they may be tenable after graduation and may therefore serve to encourage literary and scientific work.

For information as to Fellowships available in the United States and in the British Colonies, we have entered into correspondence with the Presidents of about 150 of their principal Colleges. With regard to the United States and Canada our information is probably nearly complete. From Australia and New Zealand, however, replies have not yet been received, and hence the statement given below may possibly do these colonies injustice.

The facts which we have thus gathered together we have thrown into tabular form. The contractions employed will probably not require explanation.

Fellowships, &c.	How Many.	Annual Value.	Tenable Years.	Source of Endowment.	How Awarded.	Conditions, &c.
ENGLAND.						
Oxford University.		$				
Craven Scholarships	6	400	3	Priv. Benefac.	Exam. in Classics.	
Dean Ireland's Scholarships	4	150	4	"	"	Candidates of not more than 4 years standing.
Senior Mathematical Scholarships	2	150	2	"	Exam. in Math. and Exp. Phys.	Winner to study at Oxford.
Boden Scholarships	4	250	4	"	Exam. in ancient langs.	Winner to study Sanscrit at Oxford.
Pusey and Ellerton Scholarships	3	250	3	"		Winner to study Hebrew at Oxford.
Kennicott Scholarships	1		1	"	Exam. in Hebrew.	
Burdett-Coutts Scholarships	2	180	2	"	Exam. in Geol. and Nat. Science.	
Denyer and Johnson Scholarships	2	300	1	"	Exam. in Theological subjects.	
Derby Scholarships	1	600	1	"	For distinction in Classics.	
Hertford "	1	150	1	"	Exam. in Latin.	
Davis Chinese Scholarships	1	250	2	"	Exam. in Chinese	Winner to study Chinese at Oxford.
All Souls' College—						
Fellowships	14	1,000	7	College Funds.	Exam. in Law & Hist.	
"	7	1,000	7	"	Exam. in other subjects.	
"	7	1,000	7	"		Tenable on condition of undertaking literary or scientific work.
"	3	1,000	7	"		Tenable with certain College offices.
"	2	1,000	7	"		Tenable with certain University offices.
"	12	250	7	"		Tenable by former Fellows.
	5	1,000	7	"		Tenable with certain Chairs.

Fellowships, &c.	How Many.	Annual Value.	Tenable Years.	Source of Endowment.	How Awarded.	Conditions, &c.
Oxford University.—*Con.*						
Balliol College—						
Fellowships	14	......	......	College Funds.		
Scholarships	15	400	1	"	Exam. (Elementary)	Tenable 5 years; candidates to be under 19 years of age.
Mathematical Scholarships	4	400	1	"	"	Tenable 4 years; candidates to be of not more than 1 year's standing.
Exhibitions	3	350	2	"	"	Tenable 5 years; candidates to be of not more than 2 years standing.
Warner Exhibition	1	450	1	Priv. Benefac.	"	Tenable 5 years.
Jenkyns "	2	500	4	"	......	Candidates to be of not more than 4 years standing.
Brasenose College—						
Fellowships	20	......	......	College Funds.		
Somerset Scholarships	22	250–400	1	Priv. Benefac.	Exam. (Elementary)	Tenable 5 years.
Open "	11	400	1	College Funds.	"	Tenable 5 years; candidates to be under 20.
Hulme Exhibitions	8	650	2	Priv. Benefac.	......	Tenable 4 years; candidates to be of not less than 1½ nor more than 3 years standing.
Christ Church—						
Senior Studentships	21 (?)	......	......	College Funds.		
Open Scholarships	5	400	1	"	Exam. (Elementary)	Tenable 5 years.
Scholarships	2	400	1	"	"	Tenable 1 year beyond attainment of 4 years standing.
Exhibitions	10–12	225	1	"	"	Do. Do.
Fell Exhibitions	4	200	1	Priv. Benefac.	"	Tenable 4 years from date of award.
Careswell Exhibitions	......	......	6	"	"	Tenable 10 years from date of award.
Corpus Christi College—						
Fellowships	14	......	......	College Funds.	......	Two connected with Chairs.
Scholarships	25	400	1	"	......	Tenable 5 years from matriculation.
Exeter College—						
Fellowships	12	......	......	"		
Hertford College—						
Fellowships	15	......	......	"		
"	2	......	......	"	......	Ten. only by married men for limited time.
Scholarships	30	500	1	"	Exam. (Elementary)	Tenable 5 years from award.
Jesus College—						
Fellowships	10–14	......	......	"		
Lincoln College—						
Fellowships	10	......	......	"		
Magdalen College—						
Fellowships	6	......	......	"	......	Attached to Professorships.
"	11	......	......	"	......	Held by College officials.
"	13–23	......	7	"	Exam. in various subjects.	
Demyships (Senior)	8	......	......	"	......	Candidates to have passed exams. for B.A.
Merton College—						
Fellowships	19–26	......	7	"	Exam., or Election by Coll.	Some attached to Coll. or Univ. offices, some given on condition of literary or scientific work.
Postmasterships	18	400	1	"	Exam. (Elementary) in Class., Math. and Nat. Sci. in rotation.	Tenable 5 years from award.
Exhibitions	4	300	1	"	Do. Do.	Do. Do.

Fellowships, &c.	How Many.	Annual Value.	Tenable Years.	Source of Endowment.	How Awarded.	Conditions, &c.
Oxford University.—*Con.*						
New College—						
Fellowships	5	....	....	College Funds.	....	Attached to Professorships.
"	10	....	....	"	....	Attached to Tutorships.
"	14-21	....	....	"		
Winchester Scholarships	cir. 21	400	1	"	Exam. (Elementary)	Tenable 5 years from award.
Open "	cir. 14	400	1	"	"	Do. Do.
Oriel College—						
Fellowships	15	....	....	"		
Scholarships	10	400	3	"	....	Tenable 5 years from award; candidates to be of not more than 2 yrs. standing.
Exhibitions	4	400	1	"	Exam. (Elementary)	Tenable 5 years from award.
Pembroke College—						
Fellowships	10	....	....	"		
Queen's College—						
Fellowships	15	....	....	"		
Scholarships	21	450	1	"	....	Tenable 5 years from award.
Hastings Exhibitions	27	450	1	Priv. Benefac.	....	Do. Do.
Fitzgerald "	1	350	3	"	....	Tenable 7 years from award.
Thanet "	1	200	1	"	....	Tenable 5 years from award.
Holme "	2	225	1	"	....	Do. Do.
Fox "	1	180	1	"	....	Do. Do.
Dixon "	2	180	1	"	....	Do. Do.
Tylney "	1	200	1	"	Nomination	Do. Do.
Thomas "	2	350	1	"	"	Do. Do.
Bible Clerkships	2	405	1	"	"	Do. Do.
St. John's College—						
Fellowships	7	....	....	College Funds.	....	Official.
"	2	....	....	"	....	Professorial.
"	7-11	....	7	"		
Fereday Fellowships	4	....	14	Priv. Benefac.		
Scholarships	21	....	3	College Funds.	....	Tenable 7 years from award.
"	7	....	1	"	....	Tenable 5 years from award.
Casberd Scholarships	4	400	1	Priv. Benefac.	....	Ten. 4 yrs.; cand. to be of 1 year's standing.
Trinity College—						
Fellowships	12	....	....	College Funds.		
University College—						
Fellowships	14	....	7	"		
Scholarships	17	400	1	"	....	Tenable 5 years from award.
Exhibitions	12	100-350	1	"	....	Do. Do.
"	3	350	2	"	....	Candidates of not more than 1½ year's standing; tenable 5 years from award.
"	7	250	1	"	....	Tenable 5 years from award.
Wadham College—						
Fellowships	10	....	....	"		
Scholarships	18	400	1	"	....	Tenable 5 years from award.

Fellowships, &c.	How Many.	Annual Value.	Tenable Years.	Source of Endowment.	How Awarded.	Conditions, &c.
Oxford University.—*Con.*						
Worcester College—						
Fellowships	12	$	......	College Funds.		
Scholarships	19	375	1	"	......	Tenable 5 years from award.
Cambridge University.						
Craven Scholarships	6	400	6	Priv. Benefac.	Exam. in Classics	Tenable 7 years; cand. of not more than 3 years standing.
Battie "	1	150–175	6	"	"	Do. Do.
Browne "	1	105	6	"	"	Do. Do.
Davies "	1	150	6	"	"	Do. Do.
Pitt "	1	350–400	6	"	"	Do. Do.
Porson "	1	240	1	"	"	Ten. 4 yrs, open to candidates in 2nd yr.
Waddington "	1	450	4	"	"	Tenable 5 years, open to candidates not over 3 years standing.
Bell "	8	300	1	"	"	Tenable 4 years, open to candidates not over 1 year's standing.
Barnes "	1	500	1	"	"	Do. Do.
Tyrwhitt Hebrew Scholarships	6	100–150	3	"	Exam. in Hebrew.	
Whewell Scholarships	8	250–500	4	"	Exam. in International Law.	
Balfour Studentship	1	1,000	3	"	By a Trust on recommendation.	Winner to conduct original research in Biology.
Sheepshanks Exhibition	1	250	3	"	Exam. in Astronomy.	
Gonville and Caius College—						
Fellowships	31	......	6	College Funds.	......	Tenure prolonged for University official work or for literary and scientific work.
Scholarships	6	300	3	"	Exam. (Elementary)	Awarded during B.A. course. May be held between B.A. and M.A. for special merit.
"	6	200	3	"	"	Do. Do.
"	6	150	3	"	"	Do. Do.
"	6	100	3	"	"	Do. Do.
"	2	300	3	"	Exam. in Botany and Comp. Anat.	
Tancred Studentships	5	500	3	Priv. Benefac.	......	Awarded during M.B. course. May be held 3 years after graduation.
Christ's College—						
Senior Fellowships	5–10	......	......	College Funds.	......	Tenable with University or College offices, or by men engaged in other University work, or by able men engaged in original research.
Junior "	10–5	......	6	"		
Tancred Studentships	4	500	3	Priv. Benefac.		
Clare College—						
Fellowships (Senior)	8	......	6 or more	College Funds.	......	One must be Professorial.
" (Junior)	9	......	6 or more	"		
Corpus Christ College—						
Fellowships	12	......	......	"		
Downing College—						
Fellowships	8	......	7 or more	"		
Scholarships	......	300	3	"	Exam. (Elementary)	Awarded during B.A. course, but may be extended to M.A.
Emmanuel College—						
Fellowships	......	......	6 or more	"	......	Senior Fellowship tenable with College or University offices. One is Professorial; others tenable by persons eminent in Theology, Literature or Science.

Fellowships, &c.	How Many.	Annual Value.	Tenable Years.	Source of Endowment.	How Awarded.	Conditions, &c.
Cambridge University.—*Con.*						
Emmanuel College—						
Scholarships	4	400	3	College Funds.	Exam. (Elementary)	Awarded during B.A. course, but may be held till M.A.
"	4	350	3	"	"	Do. Do.
"	4	300	3	"	"	Do. Do.
"	6	250	3	"	"	Do. Do.
"	6	200	3	"	"	Do. Do.
Thorpe Scholarships	6	150	3	Priv. Benefac.	"	Do. Do.
Dinie "	3	150	3	"	"	Do. Do.
Johnson "	4	175	3	"	"	Do. Do.
Ash "	2	250	3	"	"	Do. Do.
Smith "	1	80	3	"	"	Do. Do.
Jesus College—						
Fellowships	16	....	6 or more	College Funds.		
Scholarships	2	80	3	"	Examination	Tenable B.A. to M.A.
King's College.						
Fellowships	46	....	....	"		
Scholarships	cir. 24	400	2 or 3	"	Examination	Awarded during B.A. course, and tenable till 6 years standing is attained.
Magdalene College—						
Fellowships	7	....	....	"		
Pembroke College—						
Fellowships	13	....	....	"		
Queen's College—						
Fellowships	13	....	7	"	....	Tenure prolonged in case of Professors, Public Orators, and University and College officials.
Sidney Sussex College—						
Fellowships	10					
Senior Taylor Scholarships	6	300	3	Priv. Benefac.	Exam. in Math.	Awarded in B.A. course. May be continued till M.A.
St. Catherine's College—						
Fellowships	6	....	....	College Funds.		
St. John's College—						
Fellowships	56	....	6–11	"	....	Five held with Professorships, some by College or University officials, some by men eminent for science or learning. In these cases tenure indefinite.
Naden Studentship	1	400	3	Priv. Benefac.	Exam. in Divinity.	
Fry Hebrew Scholarship	1	160	3	"	" in Hebrew.	
Scholarships	60	250	3	College Funds.	....	Awarded in B.A. course, tenable 3 years after.
St. Peter's College—						
Fellowships	14	....	6	"	....	One Fellowship is professorial, others held by University or College officials and by eminent men. In these cases tenure prolonged.
Scholarships	22	100–400	....	"	....	Awarded on entering, tenable till B.A., but tenure may be prolonged.
Trinity College—						
Fellowships	60	....	6	"	....	Tenure prolonged in case of Professors, University and College officials, and eminent men in literature and science.

Fellowships, &c.	How Many.	Annual Value.	Tenable Years.	Source of Endowment.	How Awarded.	Conditions, &c.
Cambridge University.—*Con.*						
Trinity College—						
Scholarships	74	400	2 or 3	College Funds.	Exam. (Elementary) ..	Awarded during B.A. course. Tenable 5½ years, and may be continued.
Exhibition	1	250	3	"	" in Nat. Sci.	
Trinity Hall—						
Fellowships	13	....	6	"	....	Tenure prolonged by holding University and College offices.
Durham University.						
Fellowships	6	600	6	"	Election of Warden and Senate.	
Pemberton Fellowship	1	600	3	Priv. Benefac.	....	Winner to teach in University and study Physical Science.
Mather Scholarship	1	200	1	"	Exam. in Science.	
London University.						
Scholarships	9	250	3	Univers'y Fund (Gov't. Grant)	Exam. Three each in (1) Math., (2) Clas-s., (3) Phil.	Awarded at Graduation.
"	16	250	2	Univers'y Fund (Gov't. Grant)	Exam. Two each in (1) Exp. Phys., (2) Chem., (3) Bot., (4) Zool., (5) Physiology, (6) Phys. Geog. and Geol., (7) Medicine, (8) Law.	Do. Do.
"	4	150	2	Univers'y Fund (Gov't. Grant)	Exam. Two each in (1) Obstetrics, and (2) Forensic Medicine.	Do. Do.
Victoria University.						
Derby Scholarship	2	170	2	Priv. Benefac.	Exam. Math	Do. Do.
Mercer "	1	150	1	"	" Chem	Do. Do.
Owens' College, Manchester.						
Victoria Scholarship	1	200	2	"	" Class. (adv'd)	
Shuttleworth "	1	200	1	"	" Pol. Econ. "	
Shakspere "	1	200	2	"	" Eng. Lit. "	
Bradford "	1	225	1-2	"	" History "	
Fraser "	2	200	2	"	" Class. "	
Dalton "	1	250	2	"	" Chem. "	
" "	1	125	1	"	" Math. "	
Platt "	2	250	2	"	" hysiol. "	
Heginbottom "	1	150	2	"	" Phys. "	
Ashbury "	2	125	2	"	" Engin'ring "	
Turner "	1	125	1	"	" Medicine "	
Langton Fellowship	1	750	3	"	Exam. in any two of following: (1) Class., (2) Hist. & Pol. Econ., (3) Modern Langs., (4) Oriental Langs.	
Science and Literature Fellowships	5	500	1-3	"	Evidence of qualification.	
Mason Science College, Birmingham.						
Scholarships	2	150	1	College Funds.	Distinction in Chem. or Engineering.	
"	......	50-150	....	"	....	Holders to prosecute original research.
King's College, London.						
Warneford Scholarships	2	125	1	Priv. Benefac.	Exam. in Med. subjects	Tenable 2 years, awarded at end of 3rd year of Medical course.
Medical "	1	200	1	"	" "	Do. Do.
Daniell "	1	100	2	"	" in Prac. Chem.	
Inglis "	2	250	....	"	" Hist. & Eng. Lit.	

Fellowships, &c.	How Many.	Annual Value.	Tenable Years.	Source of Endowment.	How Awarded.	Conditions, &c.
Yorkshire College, Leeds.						
Cavendish Scholarship.......	1	250	1	"	For investigations in Natural Science.	
University College, London.						
Hume Scholarships.........	2	100	3	"	Exam. one in Jurisprudence, other in Pol. Economy.	
Ricardo "	1	100	3	"	Exam. in Pol. Econ.	
Mill "	1	100	1	"	" in Phil.	
Tuffnell "	2	500	1	"	" in Chem........	Tenable 2 years; open to candidates of 3 years standing.
Unconnected with the Universities.						
Hibbert Bursaries...........	......	1000	2	"	By Hibbert Trust, on testimonials.	Holders to study Philosophy abroad.
SCOTLAND.						
Edinburgh University.						
Pitt Club Class. Scholarship.	1	300	4	"	Ex. Classics & Eng. Lit.	
Mackenzie Class. " ..	1	600	4	"	" Classical & Eng. Lit.	
Baxter Math. " ..	1	270	4	"	" Maths. & Physics.	
Baxter Philo. " ..	1	270	4	"	" Log., Metaph., and Mor. Phil.	
Baxter Phys. Sci. " ..	1	290	2	"	" Physical Science.	
Baxter Nat. Sci. " ..	1	290	2	"	" Natural Science.	
J. E. Baxter " ..	3	500	3	"	" Class., Math., and Ment. Phil., alternately.	
Drummond Math. " ..	1	500	3	"	" Mathematics......	Winner to travel and to inspect and report on remarkable engineering structures.
Bruce Classical " ..	1	500	3	"	" Classics............	Winner to study at Edinburgh or abroad.
Bruce Philo. " ..	1	500	3	"	" Philosophy........	Do. Do.
Bruce Math. " ..	1	500	3	"	" Math. and Nat. Phil	Do. Do.
Rhind " ..	1	450	2	"	" Classics............	Winner to study at Edinburgh and take part in teaching in University.
Rhind " ..	1	450	2	"	" Philosophy........	Do. Do.
Chas. Maclaren " ..	1	500	3	"	" Math. & Nat. Phil.	Winner to travel and to inspect and report on remarkable engineering structures.
Neil Arnott " .	1	200	1	"	Excellence in Phys. Laboratory work.	Winner to assist in conducting Laboratory Classes.
Skirving Mor. Phil. " ..	1	250	3	"	Excellence in Mor. Phil	
Lang Scholarship............	4	....	....	"	....	To be founded on death of life renters: one in Math., one in Nat. Phil., one in Chem., and one in Botany.
Vans Dunlop Scholarships...	15	500	3	Priv. Benefac.	By Exam. One Schol. in each of the following subjects: (1) Eng. Lit., (2) Lat. and Gk., (3) Engineering, (4) Pol. Econ. and Mercantile Law, (5) Logic and Metaph., (6) Nat. Phil., (7) Mathematics, (8) Oriental Languages, (9) History, (10) Chemistry, (11) Nat. Hist., (12) Law; and three in Medical subjects.	Winners to prosecute study of subject in which they take scholarships.
Guthrie Fellowship	1	430	4	"	Exam. in Classical Lit.	
Hamilton "	1	455	3	"	" in Mental Phil.	
Fettes "	2	500	......	"	....	Restricted to Graduates who have been educated at Fettes College.
Falconer Memorial Fellows'p	1	540	2-4	"	" in Geol. & Palæontology.	
Research Fellowships.	5	500	1-3	"	By election of Senatus	Open to Graduates of Scottish Universities. Winners must prosecute research in Math., Chem., Biol., Ment. Phil., or History at Edinburgh University.
Pitt Club Div. Scholarship..	1	700	3	"	Examination..........	Tenable by M.A.'s who have studied Theol. 3 years.

Fellowships, &c.	How Many.	Annual Value.	Tenable Years.	Source of Endowment.	How Awarded.	Conditions, &c.
Edinburgh University.—Con.						
Maxton Div. " ..	1	200	3	Priv. Benefac.	....	Tenable by students who have completed Theol. course.
Glover Div. " ..	1	160	3	"	....	Do. Do.
Ettles " ..	1	200	1	"	To most distinguished graduate in Medicine	
Law Fellowship..............	1	500	3	"	Examination	Open to Graduates in Law.
Ellis Prize.....	1	cir. 400	1	"	For research in Physiology.	
Goodsir Prize................	1	300	1	"	For Research in Anatomy.	Awarded triennially.
Hope "	1	500	1	"	Exam. in Chem........	Winner to study Chemistry 1 year.
Murchison Scholarship......	1	250	1	"	....	Candidates must be of 4 years standing in Med. Fac.
Buchanan "	1	200	1	"	Best final exam. in Midwifery.	
Aitken Theol. "	1	500	2–3	"	Examination	Winner to study Church History and Biblical criticism at Continental Universities.
Hope Prize "	1	....	1	"	Ex. in Practical Chem.	Winner to assist Prof. of Chem. and continue study of Chemistry.
Syme Surgical Fellowship...	1	500	2	"	For Thesis on Surgery shewing original research.	
Swiney Geological Lectures'p	1	720	5	"	By Trustees of British Museum.	M.D.'s of Edinburgh only eligible.
Mackay Smith Schol........	1	250	2	"	Ex. in Nat. Phil.......	Awarded in alternate pairs of years to Edin. and Glasgow stud. respectively.
" " "	1	250	2	"	" in Chemistry.......	Do. Do.
Leckie-Mactear Fellowship..	1	400	3	"	" in Medical subjects	Winner to engage in original research.
Glasgow University.						
Snell Exhibitions............	10	650	1	"	Ex. in one or more of Classics, Math., Phil., (as in M.A. Honours Exam.).	Winners study at Balliol Col., Oxford. The Exhibitions are held during B.A. course, and for a time afterwards.
Breadalbane Scholarships...	2	250	3	"	Ex. Math. & Nat. Phil.	Winner to pursue a course of Scientific Study in Glasgow.
Eglinton Fellowships........	2	500	3	"	Ex. in Class., Phil. and Eng. Lit.	Winner to study and teach in Glasgow Univ.
Luke Fellowship.............	1	600	3	"	Do. Do.	Winner to assist in teaching Eng. Lit.
Thomson Experimental Scholarships....................	3	100	1	"	For ability shewn in Practical Physics	Winner to prosecute research in Phys. Lab.
Findlater Scholarship........	1	175	1	"	Ex. in Theology.	
Metcalfe Fellowship.........	1	500	3	"	" in Math. of M.A. Honours Exam.	Winner to prosecute study of Higher Math., or Practical Astronomy, or Engineering.
Clark Scholarship............	4	1000	4	"	" in one of the Honours Departm'nt of M.A. Course.	Winner to study and teach in Glasgow.
Scott "	1	400	2	"	" in Class., Phil., and Eng. Lit.	Winner to teach and study in Glasgow.
Black Fellowship............	1	700	2	"	" in Theology	Open to M.A.'s on completing Divinity Course.
Ewing Fellowship..	3	400	5	"	" one in each of following subjects: (1) Math. and Nat. Phil., (2) Phil., (3) Eng. Lit.	Winners to teach in University.
St. Andrew's University.						
Spence Bursaries............	8–10	250	2	"	For distinction in early part of Arts Course.	Awarded during Arts Course, but may be held two years after graduation if winner engage in professional or special study.
Ramsay Scholarship.........	2	250	4	"	Ex. in subject of M.A. Course.	
Guthrie "	4	300	2	"	" in Divinity, Class., Eng. & Math.	Awarded during Arts Course, but may be held 2 years after graduation. Winner may study abroad.
Bruce "	2	250	2	"	" in a Department of Honours for M.A.	
Aberdeen University.						
Simpson Prizes	2	325	1	"	" one in each of (1) Greek, (2) Math. (M.A. Honours).	
Boxill "	1	140	1	"	" Math., M.A. Hons.	
Hutton Classical Prize.......	1	150	1	"	" in Class. and Phil. (M.A. Honours.)	
Neil Arnott Prize............	1	175	1	"	" Exp. Physics.	

Fellowships, &c.	How Many.	Annual Value.	Tenable Years.	Source of Endowment.	How Awarded.	Conditions, &c.
Aberdeen University.—*Con.*						
Fullerton, Moir and Gray Scholarships..............	4	500	2	Priv. Benefac.	Ex. two in each of (1) Classics, (2) Ment. Phil.	
" "	3	375	3	"	" in Math. and Nat. Phil.	
Murray "	1	350	3	"	" in Classics, Math., Phil. and Sci.	For the education of "an ingenious youth," a graduate of the University, in "some liberal secular Profession."
Open to all Scottish Universities.						
Ferguson Scholarships.......	6	400	2	"	" two in each of (1) Classics, (2) Math. and Nat. Phil., (3) Phil.	Winner to prosecute studies in furtherance of the higher learning.
Shaw Fellowship.............	1	850	5	"	" in Philosophy.	
Gunning Fellowship.........	1	500	3	"	" Nat. Sci. & Theol..	Open to studts. on completing Theol. Course.
IRELAND.						
Dublin University.						
Fellowships......	31	....	....	College Funds.	" in Class., Math., Exp. Sci. & Phil.	
Studentships......	14	500	7	College Funds.	" seven in each of (1) Classics, (2) Math. and Nat. Phil.	
Scholarships.................	70	....	3	College Funds.	" in either Class. or Math. and Phil.	May be held during B.A. Course and for 3 years after. Winners have full commons, rooms and tuition at half-rate, and a salary.
Erasmus Smith Exhib.......	7	200	3	Priv. Benefac.	" (Elementary)......	Awarded at beginning of B.A. Course, tenable till M.A.
" " "	7	125	3	"	" "	
Brooke Prizes.....	2	cir. 200	1	"	" one in Class., one in Math.	
Royal University of Ireland						
Fellowships		2000				
Exhibitions..................	10	250	1	General Fund (Gov't. Grant)	Final B.A. and other exams.	
"	18	125	1	"	Do. Do.	
Studentships......	10	500	5	"	Ex. in special department of study.	
Queen's College, Belfast.						
Senior Scholarships..........	8	200	1	"	Ex. One in each of (1) Class., (2) Mod. langs. and Hist., (3) Math., (4) Nat. Phil., (5) Metaphysics and Econ. Sci., (6) Chem., (7) Nat. Hist., (8) Law.	Winner to assist in Exam. and pursue advanced course of study.
Queen's College, Cork.						
Senior Scholarships..........	8	200	1	"	Do. Do.	Do. Do.
Queen's College, Galway.						
Senior Scholarships..........	8	200	1	"	Do. Do.	Do. Do.
UNITED STATES.						
Harvard University.						
Harris Fellowship...........	1	600	1 or more	Priv. Benefac.	Election by Corporation	Winner to study at Harvard the higher branches of Science.
Rogers Scholarship..........	1	800	1 or more	"	Do. Do.	Winner to study sound literature and learning at Harvard or abroad.
Parker Fellowships..........	4	800	1-3	"	Appointment by President and Fellows.	Winner to devote himself to some special study.
Kirkland "	1	650	1-3	"	Do. Do.	Winner to study at Harvard or abroad.
Walker "	1	600	....	"	Do. Do. (with preference for candidates in Phil.)	
Morgan "	4	500	1-2	"	Appointment by President and Fellows.	Winner to undertake advanced studies at Harvard.
Scholarships.................	4	250	1	General Fund.	Do. Do. (candidates to be needy candidates for M.A. or Ph.D.)	

Fellowships, &c.	How Many.	Annual Value.	Tenable Years.	Source of Endowment.	How Awarded.	Conditions, &c.
College of New Jersey, Princeton.						
Green Mental Sci. Fellows'p.	1	600	1	Priv. Benefac.	Ex. in Ment. Phil......	Winner to study at Princeton or abroad.
Classical Fellowship.........	1	600	1	"	" in Classics	Do. Do.
1860, Exper. Sci. Fellowship.	1	600	....	"	" in Pure & Ap. Sci..	Do. Do.
J. S. K. Math. " .	1	600	1	"	" Mathematics	Do. Do.
Boudinot Hist. " .	1	250	1	"	For an essay on prescribed subject.	Winner to study History.
" Mod. Lan. " .	1	250	1	"	Ex. in Mod. Langs.....	Winner to study Mod. Languages.
E. M. Biological " .	1	600	....	"	" in Biology.........	Winner to study Biology.
Yale College, New Haven.						
Douglas Fellowship..........	1	600	1–3	"	....	Winner must pursue non-professional studies in New Haven.
Soldiers' Memorial Fellows'p	1	600	1–5	"	....	Do. Do.
Silliman Fellowship..........	1	600	1–3	"	To a graduate of promise in Phy. Science.	Do. Do.
Berkeley Scholarship	1	55	1–3	"	Ex. in Classics.........	Do. Do.
Clark "	1	120	1–2	"	" in several subjects.	Do. Do.
Larned "	1	300	3	"	....	Do. Do.
Foote "	......	500	1 or more	"	....	Winner to study in Department of Philosophy and the Arts.
De Forest "	1	120	1	"	Distinction in French..	Winner to study Romance Languages during next year.
Johns Hopkins University, Baltimore.						
Fellowships..................	20	500	1–2	Gener'l Endowment........	Evidence of success in past studies. Three in each of the following subjects: (1) Chem., (2) Physics, (3) Biol., (4) Greek, and five in other subjects.	Winner to prosecute special study at Baltimore and assist in Examinations, &c.
Columbia College, New York.						
Fellowships in Letters and in Science........	15	500	3	General Fund.	....	Winners to pursue non-professional studies at Columbia Coll. and assist in teaching.
Prize Tutorships in Law.....	3	500	3	"	....	Winners to assist in teaching.
Prize Lectureships in Political Science..................	3	500	3	"	....	Winners to give at least 20 lectures per annum on prescribed subjects.
University of the City of New York.						
Fellowship....................	1	300	1	"	....	Winner to study at the University.
"	1	200	1	"	....	Do. Do.
"	1	100	1	"	....	Do. Do.
Cornell University, Ithaca.						
Fellowships..................	7	400	1 or 2	"	For marked ability as shewn by Exam. or Testimonials.	Winners to study at Cornell.
Vanderbilt University.						
Fellowships..................	......	500	2 or more	Tuition Fees...	....	Winners to pursue studies with success.
"	......	300	2 or more	"	....	Do. Do.
Bryn Mawr College (for women), Philadelphia.						
Travelling Fellowship.......	1	500	1–2	General Fund.	For excellence in scholarship.	Winner to pursue special studies at some European University.
Resident Fellowships........	5	350	1–2	"	One for proficiency in each of the following subjects: (1) Greek, (2) English, (3) Math., (4) Hist., (6) Biol.	Winners to pursue studies at Bryn Mawr College.
Indiana University.						
Tutorships....................	4 or 5	300-1000	....	"	In Chemistry, Zoology, English, German, &c.	Winner to assist in teaching.

FELLOWSHIPS, &c.	How Many.	Annual Value.	Tenable Years.	Source of Endowment.	HOW AWARDED.	CONDITIONS, &c.
WASHINGTON AND LEE UNIVERSITY.						
Howard Houston Fellowship.	1	500	2	Priv. Benefac.	....	Winner to pursue special study at the University and assist in teaching.
OPEN TO ALL UNIVERSITIES—						
Tyndall Scholarship[1]	[illegible]	cir. 400	4	Found. by Prof. Tyndall......	By Trustees for proficiency in Physics.	Winner to study in some European Univ.
CANADA.						
UNIVERSITY COLLEGE, Toronto.						
Fellowships..................	9	500	3	General Fund.	Ex. One in each of following subjects: (1) Class., (2) Math., (3) Phil., (4) French, (5) German, (6) Chem., (7) Biol., (8) Geol.	Winner to assist in teaching and to pursue some special line of study in his own department.
TRINITY COLLEGE, Toronto.						
Fellowship.	1	500	3	Priv. Benefac.	For eminence in Biol..	Winners to conduct original investigation and to assist in teaching:
"	2	....	....	....	....	In course of foundation.
DALHOUSIE COLLEGE, Halifax.						
Munro Tutorships...........	2	1000	1–2	"	One each in Classics and Mathematics.	Winner to assist in teaching.
OPEN TO MARITIME PROVINCES—						
Gilchrist Scholarship........	1	500	3	"	Ex. (Matric. Exam. of London University).	Winner to study in Edinburgh or London. Intended to be a Scholarship, but frequently used as a Fellowship for advanced study.
AUSTRALIA.						
UNIVERSITY OF MELBOURNE.						
Scholarships................	5	225	2	General Fund	Exam. One in each of (1) Class., (2) Math. & Nat. Phil., (3) Nat. Sci., (4) History, &c., (5) Phil.	Awarded at final B.A. Exam.
Shakespeare Scholarship....	1	250	3	Priv. Benefac.	Exam. in Shakespeare's works and Essay or Poem.	Awarded after final B.A. Exam.
Argus "	1	225	2	"	Exam. (Final Honour Exam. of Engineering School.)	
Howitt Nat. Hist. Scholars'ps	3	250	3	"	Exam. in Nat. Science.	Candidates not to be of more than 3 years standing.
UNIVERSITY OF SYDNEY.						
Wentworth Travelling Fellowship....................	1	....	3	"	" Honours at B.A	Winner to study in England. Not yet awarded. The fund is accumulating.
Mackay Fellowships.........	4	2000	....	"	To Bachelors of Science by mode not yet settled.	Winners to prosecute certain specified Sciences and to hold Fellowships so long as they do so. Recently established.
NEW ZEALAND.						
UNIVERSITY OF NEW ZEALAND.						
Scholarships.................	4	....	1	Gov't Grant....	Exam. (Elementary)..	Awarded to students while at school, tenable for 8 years, the last year being spent in advanced study of science.

[1] The endowment of this Scholarship has recently been divided among three of the leading Universities of the United States.

Even a hasty glance at the above Table shews that, in the United Kingdom, very extensive provision is made for enabling students of promise to pursue their studies into the higher regions of learning, without distraction from the necessity of engaging in lucrative employment. In the United States, endowments for this purpose are not so numerous or so large, but they are growing rapidly. Universities are for the most part comparatively young and have had to employ their revenues for

the provision of Professorships, Libraries, Museums and Laboratories. Most of the Fellowships which they possess have been founded quite recently, and several Presidents of colleges have reported to us that they are making efforts to obtain the necessary endowments and hope soon to be successful.

In Canada we have made a beginning, but the beginning is small, and the few Fellowships which our Universities possess are in all cases so conditioned that their holders, being required to engage in teaching, are unable to study abroad.

There can be no doubt of the immense value of such foundations as Fellowships, especially in a country like Canada in which the class of people who are able to provide incomes for their sons, while engaged in higher studies, is small. Thoroughly trained men in all departments are wanted to fill the Professorial Chairs at our colleges, to adorn our professions and to become our leaders in the making and administration of laws. In Science they are especially wanted to hasten the development of our natural resources. In support of this position we think we need present no argument. It only remains to ask how they can be got.

The sources of the endowments as shown in the above table are three: (1) The General Endowment Fund of the university or college; (2) Direct Government Grant; and (3) Special Private Benefaction. These also are the only sources from which Canadian Fellowships can be drawn.

1. From the first there is but little hope of any adequate provision of Fellowships being made. For our colleges are in general so badly endowed that all their funds are needed to provide the first requisites of university work, Professorships, Libraries, Museums and Laboratories. In fact not one of our colleges has anything like a proper equipment.

2. Fellowships might be established by Government Grant in a variety of ways.

(*a*) Grants might be given either by Central or Local Governments to all our universities. Were these not legion, such a scheme would be practicable. But their number is such that, to carry out this scheme, an enormous grant would be necessary, and it would not in all cases be well applied.

(*b*) Grants might be given either by the Central or the Local Governments to those of our universities whose graduates are really ready to enter upon advanced work. But the difficulties of selection under this course are obvious. In some few cases the selection might be made. In those Provinces, for example, in which one university is supported either by annual grant or by public endowment, Fellowships might be provided, just as Professorships have been. In Provinces which possess no other universities, no difficulty would arise. But in others, in which universities of private foundation exist, the Government would probably find it difficult to make the necessary grant.

(*c*) The Central Government might establish Fellowships, open to the whole Dominion, and appoint a Board of Examiners to award them. This scheme is probably feasible. But the Committee make no recommendation on it at present, leaving the matter for future consideration.

(*d*) The Local Governments might establish Fellowships, open to the respective Provinces, appointing Boards of Examiners to award them. On this also the Committee make no recommendation.

3. The only other source is that from which large numbers of the Fellowships of other countries have been drawn, viz., private beneficence; and your Committee are of opinion that it is from the benefactions of the friends of education in general and of particular seats of learning that Canadian Fellowships ought to be obtained at present. The progress which some of our universities have recently made through the munificence of their graduates and of appreciative friends, justifies the hope that so soon as the utility of Fellowships is understood and their necessity perceived, the funds will be forthcoming to endow them. To bring about their endowment at the earliest possible date, possibly the best means we can immediately employ is the circulation of information as to what has already been done in other countries. Your Committee would therefore recommend that this report should be published in the Proceedings of the Society, and that a large number of separate copies should be struck off and distributed to the Heads of Canadian Universities to be distributed by them to persons whom they consider able and willing to assist in this great work.

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The Council for 1885-86 comprises the President and Vice-President of the Society, the Presidents, Vice-Presidents and Secretaries of Sections, the Honorary Secretary, and the Honorary Treasurer, besides ex-Presidents of the Society.

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SOCIÉTÉ ROYALE DU CANADA

MÉMOIRES

SECTION I

LITTÉRATURE FRANÇAISE, HISTOIRE, ARCHÉOLOGIE, ETC.

ANNÉE 1885

I — *Les premières pages de notre histoire,*

Par LOUIS FRÉCHETTE.

(Lu le 27 mai 1885).

I

ANTE LUCEM

Qui pourrait raconter ces âges sans annales ?
Quel œil déchiffrera ces pages virginales
Où Dieu seul a posé son doigt mystérieux ?
Tout ce passé qui gît, sinistre ou glorieux,
Tout ce passé qui dort, heureux ou misérable,
Dans les bas-fonds perdus de l'ombre impénétrable,
Quel est-il ?
A ce sphinx sans couleur et sans nom,
Plus muet que tous ceux des sables de Memnon,
Et qui, de notre histoire encombrant le portique,
Entr'ouvre dans la nuit son œil énigmatique,
A tant de siècles morts, l'un par l'autre effacé,
Qui donc arrachera le grand mot du passé ?

Hélas ! n'y songeons point ! En vain la main de l'homme
Joue avec les débris de la Grèce et de Rome,
Nul bras n'ébranlera le socle redouté
Qui depuis si longtemps, rigide majesté,
Plus lourd que les menhirs de l'époque celtique,
Pèse, ô vieux Canada, sur le sépulcre antique
Où, dans le morne oubli de l'engloutissement,
Ton tragique secret dort éternellement !
Ce secret, ô savants, ni vos travaux sans nombre,
Ni vos soirs sans sommeil n'en découvriront l'ombre.
Pas un jalon au bord de ce gouffre béant !
Pas un phare au-dessus de ce noir océan !
Point d'histoire !... une nuit sans lune et sans étoiles,
Dont jamais œil humain ne percera les voiles !

Et cependant le globe au loin fermente et bout.
Là-bas, au grand soleil, l'humanité debout,

Un reflet d'or au fer de sa lance guerrière,
Dans l'éclair et le bruit dévore sa carrière.
Là, tout germe, tout naît, tout s'anime et grandit ;
Du haut des panthéons dont le front resplendit,
La trompette à la bouche, on voit les Renommées,
Dans l'éblouissement des gloires enflammées,
Pour l'immortalité jeter aux quatre vents
Le nom des héros morts et des héros vivants,
Pour que dans le passé l'avenir sache lire,
Des poètes divins ont accordé leur lyre,
Et mêlent, dans l'éclat de leurs chants souverains,
Les clameurs d'autrefois aux bruits contemporains ;
Le Progrès, dans son antre où maint flambeau s'allume,
Sous son marteau puissant fait résonner l'enclume
Où se forge déjà la balance des droits,
Où pèseront plus tard les peuples et les rois ;
La Science commence à voir au fond des choses ;
Les Arts, ces nobles fleurs au vent du ciel écloses,
Entr'ouvrent leur corolle au fronton des palais ;
Que dis-je ? la Nature elle-même, aux reflets
Des nouvelles clartés que chaque âge lui verse,
Sourit plus maternelle en sa grâce diverse ;
La mamelle épuisée à nourrir ses enfants,
Dans des élans de joie et d'amour triomphants
Elle s'ouvre le flanc pour sa progéniture ;
Et, dans son noble orgueil — sainte et grande Nature ! —
Mêle son cri sublime à l'hymne solennel
Qui monte tous les jours de l'homme à l'Eternel.

Pourquoi cette antithèse et ce contraste immense ?
Celui par qui tout meurt et par qui tout commence,
Par qui tout se révèle ou tout reste scellé,
Celui qui fit les fleurs et l'azur constellé,
Qui veut que tout renaisse et veut que tout s'effondre,
Arbitre sans appel, pourrait seul nous répondre !

Aux bords ensoleillés de ton beau Saint-Laurent,
Ou sous l'ombre des bois au rythme murmurant
Qui te prêtent leur sombre et riche draperie,
Quand le désœuvrement conduit ma rêverie,
O beau pays, dont j'aime à sonder le destin,
Je remonte souvent vers ce passé lointain.
Je parcours en esprit tes vastes solitudes ;
Je toise de tes monts les fières altitudes ;

Je me penche au-dessus de tes grands lacs sans fond ;
Je mesure les flots du rapide profond ;
Et, devant ce spectacle, impondérable atome,
De ces jours sans soleil j'évoque le fantôme.

Tout change à mes regards ; le présent disparaît ;
Nos villes à leur tour font place à la forêt ;
Tout retombe en oubli, tout redevient sauvage ;
Nul pas civilisé n'a foulé le rivage
Du grand fleuve qui roule, énorme et gracieux,
Sa vague immaculée à la clarté des cieux !
De ton tiède Midi jusqu'aux glaces du pôle,
Tes hauts pics n'ont encor porté sur leur épaule,
O Canada, connu du seul oiseau de l'air,
Que l'ombre de la nue et le choc de l'éclair !
Tout dort enveloppé d'un mystère farouche ;
Seul, parfois, quelque masque au regard sombre et louche,
Effaré, menaçant comme un fauve aux abois,
Apparaît tout à coup dans la nuit des grands bois !...
Quels tableaux ! —
Et devant cette nature immense,
Dans un rêve profond qui toujours recommence,
Je crois entendre encor bourdonner dans les airs
Les cent bruits que le vent mêle, au fond des déserts,
Aux tonnerres que roule au loin la cataracte.

Puis je tombe à genoux : — sublime et dernier acte,
Ou prologue plutôt du drame éblouissant
Qui va donner un peuple à ce pays naissant, —
Sur ces bords inconnus pour le reste du monde,
Sur ces flots que jamais n'a pollué la sonde,
Sur ces parages pleins d'une vague terreur,
Sur cette terre vierge où plane en son horreur
Le mystère sacré des ténèbres premières,
J'ai vu surgir, foyers de toutes les lumières,
Dans un rayonnement de splendeurs infini,
Le soleil de la France et son drapeau béni !

II

LE DÉPART

Un vent de renouveau sur la France soufflait.
Son diadème d'or se nimbait au reflet

Du radieux soleil qui fut la Renaissance.
Le roi François-premier, par sa magnificence,
— N'ayant pu, dans sa soif ardente de jouir,
Vaincre l'Europe — au moins tâchait de l'éblouir !

Chez lui le goût des arts à la grandeur s'allie.
Il attire à prix d'or, du fond de l'Italie,
Pour les combler d'honneurs, peintres napolitains,
Architectes lombards et sculpteurs florentins.
De Vinci, del Sarto, Rosso sont à l'ouvrage ;
Et l'on surprend souvent, le matin, sous l'ombrage
Des grands massifs touffus où dort Fontainebleau,
Le monarque — j'ai vu quelque part ce tableau —
Beau comme Louis-neuf à son lit de justice,
Bras dessus bras dessous avec le Primatice !

Un monde de splendeurs germe dans son cerveau ;
Il rêve tous les jours quelque projet nouveau
Qu'il faut que le génie à l'instant réalise.
Avec ces étrangers la France rivalise.
Peintres, sculpteurs, lettrés, architectes hardis,
Satiristes profonds, raisonneurs érudits
Surgissent à la voix du prince galant homme ;
Delorme va cueillir des lauriers jusqu'à Rome ;
Celui-ci c'est Bontemps, celui-là Rabelais ;
Palissy fouille l'or, et Lescot des palais ;
Ici Jean Cousin lutte avec Jean de Bologne ;
Tandis qu'au fond d'un bois de la verte Sologne,
Bâti par Le Nepveu, sculpté par Jean Goujon,
Forteresse royale au féerique donjon,
Brillant comme un foyer de kaléidoscope,
Rendez-vous des futurs potentats de l'Europe,
Chambord, hymne de pierre et rêve de granit,
Chef-d'œuvre que le temps chaque jour rajeunit,
Entr'ouvre, dans un jet d'une audace inconnue,
Sa fleur de lys de marbre au milieu de la nue !

Les arts ont eu leur tour, la science a le sien :
Tous les jours on résout quelque problème ancien ;
Enfin, tout se réveille et se métamorphose...

C'était le temps marqué pour une grande chose !

De l'Occident lointain venaient d'étranges bruits
Qui du roi chevalier souvent troublaient les nuits.

On parlait à la cour de vastes découvertes
De cieux toujours sereins, de plaines toujours vertes,
Paradis merveilleux, édens sans fruits amers,
Qu'un Génois avait fait surgir du fond des mers.
On avait retrouvé la source de jouvence ;
Et, de Strasbourg à Brest, de Champagne en Provence,
Les raconteurs faisaient de saisissants tableaux
De fleuves sans pareils roulant l'or dans leurs flots,
De peuples primitifs plongés dans l'ignorance,
Et qui tendaient les bras, disait-on, vers la France !

Dans les enivrements d'un succès sans égal,
L'Espagne et l'Angleterre avec le Portugal,
Par des redoublements de valeur surhumaine,
Se taillant sur ces bords un immense domaine,
Aux vents du nouveau monde arboraient leurs drapeaux.
— Allons, se dit François, plus de lâche repos !
Ces princes-là croient-ils se partager la terre ?
Je voudrais bien trouver l'acte testamentaire
Qui leur assure ainsi l'héritage d'Adam.
S'il en est un, qu'on nous le montre ! En attendant,
Le peuple franc se doit à son rôle historique :
A la France, elle aussi, sa part de l'Amérique !

Voici l'âpre océan. La houle vient lécher
Les sables de la grève et le pied du rocher
Où Saint-Malo, qu'un bloc de sombres tours crénelle,
Semble veiller, debout comme une sentinelle.
Le soleil verse un flot de rayons printaniers
Sur les toits de la ville et sur les blancs huniers
Qui s'ouvrent dans le port prêts à quitter la côte.

C'est un jour solennel, jour de la Pentecôte ;
La cathédrale a mis ses habits les plus beaux ;
Sur les autels de marbre, un essaim de flambeaux
Lutte dans l'ombre avec les splendeurs irisées
Des grands traits lumineux qui tombent des croisées.
Agenouillé tout près des balustres bénits,
Un groupe de marins que le hâle a brunis,
Devant le Dieu qui fait le calme et la tempête,
Dans le recueillement prie en courbant la tête.
Un homme au front serein, au port ferme et vaillant,
Calme comme un héros, fier comme un Castillan,
L'allure mâle et l'œil avide d'aventure,
Domine chacun d'eux par sa haute stature.

C'est Cartier ; c'est le chef par la France indiqué ;
C'est l'apôtre nouveau par le destin marqué
Pour aller, en dépit de l'océan qui gronde,
Porter le Verbe saint à l'autre bout du monde !
Un éclair brille au front de ce prédestiné.

Soudain, du sanctuaire un signal est donné,
Et, sous les vastes nefs pendant que l'orgue roule
Son accord grandiose et sonore, la foule
Se lève, et, délirante, en un cri de stentor,
Entonne en frémissant le *Veni Creator !*

De quels mots vous peindrais-je, ô spectacle sublime ?
Jamais, aux jours sacrés, des parvis de Solime,
Chant terrestre qu'un chœur éternel acheva
Ne monta plus sincère aux pieds de Jéhova !
L'émotion saisit la foule tout entière,
Quand, du haut de l'autel, l'homme de la prière,
Emu, laissa tomber ces paroles d'adieu :
— Vaillants chrétiens, allez sous la garde de Dieu !

O mon pays, ce fut dans cette aube de gloire
Que s'ouvrit le premier feuillet de ton histoire !

Trois jours après, du haut de ses mâchecoulis
Par la flamme et l'obus mainte fois démolis,
Saint-Malo regardait, fendant la vague molle,
Trois voiliers qui doublaient la pointe de son môle,
Et, dans les reflets d'or d'un beau soleil levant,
Gagnaient la haute mer toutes voiles au vent.

Le carillon mugit dans les tours ébranlées ;
Du haut des bastions en bruyantes volées,
Le canon fait gronder ses tonnantes rumeurs ;
Et, salués de loin par vingt mille clameurs,
Au bruit de l'airain sourd et du bronze qui fume,
Cartier et ses vaisseaux s'enfoncent dans la brume !

III

TERRE !

Le voyage fut rude et le péril fut grand.
Pourtant, après avoir, plus de deux mois durant,

Vogué presque à tâtons sur l'immensité fauve,
La petite flottille arriva saine et sauve
Auprès de bords perdus sous d'étranges climats...
Terre ! cria la voix d'un mousse au haut des mâts.

C'était le Canada, mystérieux et sombre,
Sol plein d'horreur tragique et de secrets sans nombre,
Avec ses bois épais et ses rochers géants,
Emergeant tout à coup du lit des océans !

Quels êtres inconnus, quels terribles fantômes
De ces forêts sans fin hantent les vastes dômes,
Et peuplent de ces monts les repaires ombreux ?
Quel génie effrayant, quel monstre ténébreux
Va, louche Adamastor, de ces eaux diaphanes
Surgir pour en fermer l'entrée à ces profanes ?
Aux torrides rayons d'un soleil aveuglant,
Le cannibale est là peut-être, l'œil sanglant
Comme un tigre, embusqué derrière cette roche,
Qui guette, sombre et nu, l'imprudent qui s'approche.
Point de guides ! Partout l'inexorable accueil !
Ici c'est bas-fond, là-bas c'est un écueil ;
Tout semble menaçant, sinistre, formidable ;
La côte, noirs rochers, se dresse inabordable.

N'est-ce pas tenter Dieu, l'invisible témoin
Qui dit au flot des mers : Tu n'iras pas plus loin !
Que vouloir avancer quand tout barre la route ?
Cartier et ses Bretons vont reculer sans doute ;
Devant ces lieux qu'ils croient d'un impossible abord,
Déçus, découragés, ils vont virer de bord...
Non ! ces forts ont le cœur ceint d'une triple armure.
A la voix de son chef pas un seul ne murmure ;
Chacun d'eux l'a promis, ils iront jusqu'au bout !

— En avant ! dit Cartier qui, front grave, et debout,
Foule d'un pied nerveux le pont de la dunette,
Et, pilote prudent, promène sa lunette
De tribord à bâbord, sondant les horizons.
Alors, défiant tout, naufrage et trahisons,
Pavillons déployés, *Grande* et *Petite Hermine*,
Avec l'*Emerillon* qui dans leurs eaux chemine,
Le Breton, qu'on distingue à son torse puissant,
Jalobert, le hardi caboteur d'Ouessant,

Qu'on reconnaît de loin à sa taille hautaine,
Tous, au commandement du vaillant capitaine,
Entrent dans l'entonnoir du grand fleuve inconnu.

Sombre aspect ! De forêts un réseau continu
Se déploie aussi loin que le regard s'élance.
Nul bruit ne vient troubler le lugubre silence
Qui, comme un dieu jaloux, pèse de tout son poids
Sur cette immensité farouche des grands bois.
A gauche, des plateaux perdus dans les nuées ;
A droite, des hauteurs qu'on dirait remuées
Par quelque cataclysme antédiluvien ;
En face, l'eau du fleuve immense, qui s'en vient
Rejaillir sur la proue en gerbes écumantes ;
Des îlots dénudés par l'aile des tourmentes ;
De grands caps désolés s'avançant dans les flots ;
Des brisants sous-marins, effroi des matelots ;
Des gorges sans issue où le mystère habite ;
Partout l'austérité du désert sans limite,
La solitude morne en sa sublimité !

Pourtant, vers le couchant le cap orienté,
La flottille s'avance, et sans cesse, à mesure
Que les lointains brumeux que la distance azure
Se dessinent plus clairs aux yeux des voyageurs,
Rétrécissant aussi ses immenses largeurs,
Le grand fleuve revêt un aspect moins sauvage ;
Son courant roule un flot plus calme ; le rivage
Si sévère là-bas devient moins tourmenté ;
Et, tout en conservant leur fière majesté,
Ces vastes régions que le colosse arrose,
Où dort la forêt vierge, et dont le regard ose,
Pour la première fois sonder les profondeurs,
Se drapent par degrés d'éclatantes splendeurs.

Le coup d'œil constamment se transforme et varie.
Enfin, la rive, ainsi qu'un décor de féerie,
Sous le flot qui se cabre en un brusque détour,
S'entr'ouvre, et tout à coup laisse voir le contour
D'un bassin gigantesque où la Toute-Puissance
Semble avoir mis le comble à sa magnificence.
Un cirque colossal de sommets inclinés ;
Un vaste amphithéâtre aux gradins couronnés
De bosquets onduleux aux teintes indécises ;
Un promontoire à pic aux énormes assises ;

Au fond de l'horizon un bleuâtre rideau
Sur lequel se détache une avalanche d'eau,
Avec d'âpres clameurs croulant dans un abîme...
Partout, au nord, au sud, la nature sublime
Dans le cadre idéal d'un conte d'Orient !

Cartier est là, debout, glorieux, souriant,
Tandis que ses Bretons, penchés sur les bordages,
Groupés sur les tillacs, suspendus aux cordages,
Par un long cri de joie immense, spontané,
Eveillent les échos du vieux Stadaconé.
Puis, pendant qu'on évite au courant qui dévire,
Chacun tombe à genoux sur le pont du navire ;
Et ces bois, ces vallons, ces longs côteaux dormants,
Qui n'ont encor vibré qu'aux fauves hurlements
Des fauves habitants de la forêt profonde,
Au milieu des rumeurs de la chute qui gronde,
Retentissent enfin — jour régénérateur ! —
Pour la première fois d'un hymne au Créateur.

Le lendemain matin, au front de la montagne
D'où Québec aujourd'hui domine la campagne,
Une bannière blanche au pli fleurdelysé,
Drapeau par la tempête et la mitraille usé,
Flottait près d'une croix, symbole d'espérance.

Le soleil souriait à la Nouvelle-France !

Ce jour est déjà loin ; mais gloire à toi, Cartier !
Gloire à vous, ses vaillants compagnons, groupe altier
De fiers Bretons taillés dans le bronze et le chêne !
Vous fûtes les premiers de cette longue chaîne
D'immortels découvreurs, de héros canadiens
Qui, du grand nom français inflexibles gardiens,
Sur ce vaste hémisphère où l'avenir se fonde,
Ont reculé si loin les frontières du monde !

IV

LA PREMIÈRE MOISSON

Ce site c'est Québec.
Au nord montent, splendides,
Les échelons lointains des vastes Laurentides.
En bas, le fleuve immense et paisible, roulant
Au soleil du matin son flot superbe et lent,

Reflète, avec les pins des grands rochers moroses,
Le clair azur du ciel et ses nuages roses.

Nous sommes en septembre ; et le blond Fructidor,
Qui sur la plaine verte a mis des teintes d'or,
Au front des bois bercés par les brises flottantes
Répand comme un fouillis de couleurs éclatantes ;
On dirait les joyaux d'un gigantesque écrin.
Un repos solennel plein de calme serein
Plane encor sur ces bords où la chaste Nature,
Aux seuls baisers du ciel dénouant sa ceinture,
Drapée en sa sauvage et rustique beauté,
Garde encor les trésors de sa virginité.

Cependant un lambeau de brise nous apporte
Comme un refrain joyeux, qu'une voix mâle et forte,
Mêlée à des éclats de babil argentin,
Jette dans l'air sonore aux échos du lointain.
Ce sont des moissonneurs avec des moissonneuses.
Ils suivent du sentier les courbes sablonneuses,
Et, le sac à l'épaule, ils cheminent gaîment.
Ce sont des émigrés du doux pays normand,
Des filles du Poitou, de beaux gars de Bretagne,
Qui viennent de quitter leur lande ou leur campagne
Pour fonder une France au milieu du désert.

L'homme qui les conduit, c'est le robuste Hébert,
Un vaillant ! le premier de cette forte race
Dont tout un continent garde aujourd'hui la trace,
Qui, dans ce sol nouveau par son bras assaini,
Mit le grain de froment, trésor du ciel béni,
Héritage sans prix dont la France féconde,
Dans sa maternité, dota le nouveau monde !
Ils vont dans la vallée où les vents assoupis
Font ondoyer à peine un flot mouvant d'épis
Qu'ont mûris de l'été les tépides haleines.

Bientôt le blé jauni tombe à faucilles pleines ;
La javelle, où bruit un essaim de grillons,
S'entasse en rangs pressés au revers des sillons,
Dont le creux disparaît sous l'épaisse jonchée ;
Chaque travailleur s'ouvre une large tranchée ;
Et sous l'effort commun, le sol transfiguré
Laisse choir tout un pan de son manteau doré.

Le soir arrive enfin, mais les gerbes sont prêtes ;
On en charge à pleins bords les rustiques charrettes
Dont l'essieu va ployant sous le noble fardeau ;
Puis, presque recueilli, le front ruisselant d'eau,
Pendant que, stupéfait, l'enfant de la savane
Regarde défiler l'étrange caravane
Et s'étonne à l'aspect de ces apprêts nouveaux,
Hébert, qui suit ému le pas de ses chevaux,
Rentre, offrant à Celui qui donne l'abondance
La première moisson de la Nouvelle-France !

II — *Prétendues origines des Canadiens-français,*

Par BENJAMIN SULTE

(Lu le 28 mai 1885)

I

Sait-on généralement, dans la classe des lecteurs, à quelle date et de quelle manière a commencé le peuplement du Canada par l'élément français ? Non. Cette chose si facile à comprendre n'est pas comprise. Le public se contente de trois ou quatre phrases toutes faites que les orateurs et les écrivains répètent comme si c'était parole d'Evangile — et personne ne conteste.

Récapitulons ce que les livres nous enseignent sur ce sujet. La question n'est pas difficile à résoudre.

Le baron de Léry avait tenté, en 1518, d'établir une colonie dans le nord de l'Amérique. Sa démarche aboutit à l'échec de l'île de Sable. L'histoire en est connue. Personne n'est justifiable de dire que, peut-être, certains hommes, échappés de cette bande de malheureux naufragés, ont pu se rendre soit en Acadie soit sur d'autres points des côtes du continent, et y donner naissance à des métissages, dont les Français, par la suite, auraient recueilli les bénéfices sous forme de colons ou de coureurs de bois. L'entreprise du baron de Léry ne dépassa jamais la mesure d'une simple tentative ; elle ne produisit pas le moindre résultat sous le rapport de la colonisation. Que sa troupe ait été composée de criminels, ou de pauvres diables, ou de chercheurs d'aventures, cela importe peu — l'essentiel est de savoir que personne n'a survécu à l'expédition avec chance de pénétrer au Canada. Ceux qui veulent se donner le malin plaisir de faire naître des soupçons sur ce sujet seraient fort en peine d'invoquer des pièces justificatives, ou même un raisonnement plausible. Ce fut un coup manqué sur toute la ligne. Il n'en resta aucune trace en Amérique — sauf les petits chevaux de l'île de Sable, et encore cela n'est pas prouvé.

Avec Cartier, il semble que la situation se prête davantage aux conjectures. Pourtant il n'en est rien. Lisez les narrations du découvreur du fleuve Saint-Laurent, et tout ce qui peut servir à mettre ses travaux en lumière. Nulle part vous ne trouverez l'ombre d'un fait qui ouvre la porte aux suppositions des avocats de la thèse que j'attaque ici. Rien, absolument rien n'autorise le critique à dire que notre pays a conservé des hommes de Cartier ou de Roberval (1534-1544), et lorsque les auteurs de notre temps font descendre une partie des Canadiens-français des équipages de Cartier, ils disent une chose de pure fantaisie.

Plus tard le marquis de La Roche reçut permission de fonder une colonie, mais il ne leva pas l'ancre des ports de France.

Dans l'*Histoire des Canadiens-français*, j'ai raconté les entreprises des Malouins et autres

Français qui, de 1544 à 1608, ont tenté de faire du trafic au Canada, jamais de la colonisation. Ce sujet si intéressant n'a pas attiré l'attention de la presse, mais quoi que l'on affirme, les " descendants " de Cartier ne comptent que pour zéro au milieu de nous, et les Malouins, successeurs du grand homme, n'ont pas non plus laissé de traces de leurs familles sur les bords du Saint-Laurent. Un peu de traite de pelleteries avec les sauvages ; un ou deux navires tous les trois ou quatre ans, voilà tout. Jamais, de 1544 à 1608, il n'y a eu d'établissement stable dans nos parages. Les documents ne permettent pas de supposer un commencement de colonisation, fût-ce même le plus défectueux : l'on n'y songeait aucunement. Mon opinion n'est point basée sur ce que je ne sais pas, mais sur ce que j'ai lu, et je crois avoir lu tout ce qui concerne ce sujet.

Il y a une étude à faire des lettres, narrations et rapports de Champlain, de 1608 à 1629. Ces écrits démontrent clairement : 1o que le Canada ne renfermait aucun habitant de race blanche avant 1608 ; 2o que nulle colonisation n'y avait pris racine, ni laissé de représentant direct ni de métis connus ; 3o que la plupart des hommes venus ici, de 1608 à 1629, n'y travaillèrent que temporairement au compte des chefs de la traite ; 4o que, à l'époque de la prise de Québec par Kertke (1629), le pays ne renfermait qu'une seule famille et un petit nombre d'individus, dont les noms ne sont plus un mystère et dont la destinée pour la plupart est facile à suivre. Ceux d'entre eux qui nous échappent, après cette date, n'étaient ni assez nombreux, ni gens assez entreprenants pour avoir créé à côté de nous un monde de brigands ou de métis. Je dis brigands pour satisfaire les écrivains qui nous injurient, et métis pour quiconque veut nous infiltrer du sang sauvage dans les veines, sans expliquer pourquoi.

Il n'y a pas eu de colons au Canada avant Louis Hébert (1617). Il n'y a pas eu non plus avant 1644 de famille formée du mélange de blancs et de sauvages — et en tout cas, s'il y en a eu, cela ne peut compter, puisque nous n'avons pas un individu provenant de cette source. A partir de 1629, *toutes* nos familles ont leur lignée parfaitement établie.

La recherche, tant pour les enfants perdus de la France que pour le métissage, doit se faire entre les deux dates 1518 et 1629. Je nie l'existence de ces deux classes d'individus, et je défie le plus savant des historiens et des curieux de mettre au jour des révélations susceptibles d'ébranler ce que je viens de dire.

Par mes articles *Les interprètes du temps de Champlain*, *Les premiers seigneurs du Canada*, et *Poutrincourt en Acadie*, le lecteur des Mémoires de la Société Royale peut se former une idée exacte des débuts de nos établissements.

On verra par la suite, si la Société Royale accepte ce que j'aurai à dire, que tout est clair et lucide dans le premier chapitre de notre histoire, et que les ignorants seuls parlent de déserteurs de navires, de condamnés en cours de justice, de vauriens, d'aventuriers, de gens de sac et de corde, qui auraient composé la première population de la colonie.

Mais ici je m'arrête pour faire un reproche aux écrivains canadiens-français : ce sont eux qui ont créé cette légende des métissages, des criminels, des vagabonds, des réfractaires, prétendue source première de notre population.

Oui ! nos journalistes s'appliquent, sans se comprendre eux-mêmes, à faire comprendre que les premiers Canadiens étaient des misérables, des vauriens, des expulsés de France.

Messieurs de la section française de la Société Royale, si vous voulez m'adjoindre deux collègues, nous examinerons au hasard une année de nos journaux, et si nous n'y trou-

vous pas une fois par semaine, c'est-à-dire cinquante fois durant l'année, des phrases comme celles-ci, je ferai amende honorable à la presse :

" Nous, les descendants des compagnons de Jacques Cartier." Pouvez-vous me désigner un seul des compagnons de Cartier qui ait laissé des descendants au Canada ?

" Fils de la Bretagne et de la Normandie, les Canadiens-français chérissent toujours la France." Remarquez bien que, de 1632 à 1700, il n'est pas venu ici cent individus de famille bretonne. Nos écrivains disent " Bretagne " parce qu'ils sont hantés par cette croyance que Cartier a colonisé le Canada. Les premières familles bretonnes sont arrivées sur le Saint-Laurent un siècle et plus après Cartier.

" Les pionniers de notre pays furent le marquis de La Roche, Roberval, Cartier, Chauvin, etc." Il faudrait dire découvreurs ou entrepreneurs de traite, afin de ne pas tromper celui qui nous lit et qui prend le mot pionnier pour synonyme de colonisateur.

" La foi chrétienne a été implantée sur les bords du Saint-Laurent par Cartier, Roberval, Champlain." Oui, Champlain, mais pas Cartier, pas Roberval ! Canadiens, ne répétez plus cette phrase qui vous fait déshonneur, et qui par-dessus le marché est un mensonge.

Le résultat de ces affirmations, si fréquentes dans la presse de la province de Québec, est de faire croire aux Européens, aux Américains et même aux Anglais qui nous entourent, que nos origines sont impures.

Etant donné le fait bien connu que le baron de Léry, le marquis de La Roche, Cartier, Roberval, projetaient de fixer ici des hommes et des femmes tirés des prisons du royaume, il est tout naturel qu'en lisant dans nos journaux des déclarations de parenté comme celles que je viens de citer, les étrangers en tirent une conclusion brutalement logique et terriblement à notre désavantage.

J'ai eu plusieurs fois occasion de constater ce déplorable résultat. Quel plaisir singulier prenons-nous donc à dire : " Nos ancêtres étaient peu nombreux, il est vrai, mais c'étaient de la canaille." Le jour viendra où des Anglais instruits en ces matières, comme MM. William Kirby, John Lespérance, John Reade, George Stewart, protesteront contre ce travestissement de l'histoire et nous demanderont pourquoi nous cherchons à nous noircir nous-mêmes !

L'an dernier, après que j'eusse répondu à la Société historique du Wisconsin, à peu près dans les termes du présent article, le secrétaire de ce corps savant et très-digne d'attention me passa une réplique en ces termes : " Je veux croire que, parvenu à 1630, au moment où, selon vous, allait commencer la colonisation du Canada, il n'existait aucune trace des hommes de Cartier, Roberval ou Chauvin ; mais vous soutenez cela parce que vous n'avez pas retrouvé ces traces : elles pouvaient exister."

Sans doute qu'elles pouvaient exister ; mais en ce cas c'était parmi les sauvages, et non pas parmi nous.

Si des aventuriers ont pris terre sur les bords du Saint-Laurent et y sont demeurés, à une date antérieure à la fondation du petit poste de Québec (1608), il ont dû être absorbés par les tribus de ces contrées. En quoi cela pourrait-il avoir du rapport avec nos familles canadiennes ?

Si, pour vous complaire, j'accorde que des enfants sont nés d'un fort petit nombre d'aventuriers quelconques perdus dans les forêts du Canada avant 1608 ou 1630, ceux-ci n'ont pu constituer un noyau de population blanche. Leur demi-sang français a dû se perdre dans des alliances subséquentes avec les sauvages.

Sur quoi se fonde-t-on pour dire que nous avons, par la suite, recueilli ces cousins de la main gauche ? Rien n'était plus défendu par les autorités, dès l'origine de la colonie française, que les mariages avec les naturels du pays. D'autre part, nos archives sont tellement complètes que nous retraçons les premiers ménages, comme s'il s'agissait d'événements survenus hier. Où placerez-vous les métis que vous avez créés par supposition ?

C'est en raisonnant de la sorte que j'ai empêché, l'an dernier, la publication d'un article destiné à prouver aux lecteurs des Etats-Unis que nous descendons des repris de justice amenés par les découvreurs du Saint-Laurent. Fasse le ciel que je réussisse maintenant à faire comprendre aux Canadiens la nécessité de ne plus parler de ces choses sans les connaître !

Notre population descend des hommes que dirigeait Champlain ; et même il faut dire, pour être exact, que les premiers colons ne datent que de l'année 1632. Tout ce qui s'est passé avant cette date appartient à l'histoire du pays — mais pas à l'histoire des Canadiens-français.

II

Citer des pièces et des documents serait chose très-facile dans ce travail ; mais, outre que la plupart de ces témoignages du temps sont connus, j'y vois l'inconvénient d'allonger mon article au point d'en faire une brochure. Ensuite, comme je me pose dans la négative, c'est-à-dire que je nie les assertions relatives au caractère douteux des premiers Canadiens, il me semble que la preuve de ces assertions ou accusations devrait être faite par ceux qui les expriment.

Bien entendu, je parle à des gens déjà versés dans la connaissance de l'histoire, et non à ceux qui, à tout propos, demandent qu'on leur apporte une bibliothèque de citations, sous prétexte qu'ils ne savent rien des choses dont vous les entretenez.

Demandons-nous d'abord sous quels auspices se sont formées les plus anciennes paroisses ou seigneuries du Bas-Canada. La réponse est des moins difficiles à trouver. Trois influences, qui en somme n'en composaient qu'une seule, prévalurent absolument de 1632 à 1661 : les Cent-Associés, les jésuites, les communautés religieuses, hommes ou femmes. Retournez les papiers, les écrits et les relations de cette époque, tâchons de lire entre les lignes, commentez toujours, vous vous apercevrez que la colonie était entièrement au pouvoir de ces influences.

La compagnie des Cent-Associés se proclamait avant tout dévouée à la cause de la morale. Les jésuites étaient les conseillers de la compagnie — j'allais dire ses dominateurs. Voilà les deux mains qui tenaient surtout le Canada.

Les ursulines et les hospitalières de Québec ajoutèrent au poids de l'élément religieux. La société de Montréal était, on peut le dire, une organisation religieuse et presque point autre chose.

Ces simples réflexions suffiraient à nous démontrer quelle classe de colons ou habitants a due être choisie pour commencer nos établissements. S'il y a place aux reproches, c'est plutôt parce que l'esprit religieux absorbait trop complètement la situation en paralysant les efforts qui n'avaient pas pour auteurs les groupes mentionnés il y a un instant.

Il est donc aisé de nous figurer quelle population se laissa attirer vers notre pays dans de telles conditions.

Celui qui ne redoute pas le travail peut scruter par les détails toute l'histoire de cette période éloignée. Les documents abondent ; ils confirment ce que je dis.

Les seigneurs étaient soumis à l'obligation de faire habiter leurs domaines. Dans leur propre intérêt, ils choisissaient de jeunes ménages, experts en agriculture, recrutés par parenté dans une ou deux communes de France, afin de les tenir unis et de reproduire sur les bords du Saint-Laurent une copie aussi exacte que possible des us et coutumes de la région d'où venaient ces paysans. De cette manière naquirent les *habitants.* N'y a-t-il pas dans tout cela de quoi satisfaire les investigateurs les plus sévères ?

On s'est demandé si le nombre des femmes correspondait, durant ces trente années, à celui des hommes. Des calculs ont été faits qui montrent que les deux chiffres étaient assez rapprochés l'un de l'autre. Jusqu'à 1650, les hommes l'emportent dans la proportion de huit contre six, ou à peu près ; mais de 1650 à 1664 l'équilibre se rétablit.

Jusqu'à 1664, les garnisons ne dépassaient guère une trentaine de soldats pour tout le pays. Les colons en âge de porter les armes étaient miliciens.

Lorsque je mentionne ces faits relatifs au nombre des femmes et des soldats, on comprend sur quoi je désire attirer l'attention.

En somme, nous ne formions, tous et toutes compris, qu'une population de moins de trois mille âmes vers 1664.

De 1640 à 1664, la guerre avait constamment fait rage autour de nous : d'une part, la colonie n'avait pu s'accroître vite, et d'un autre côté les garnements n'étaient pas tentés de quitter la France pour venir rencontrer l'Iroquois.

Ainsi donc : influence religieuse prépondérante qui mettait obstacle au mauvais choix des colons ; et situation militaire peu attrayante pour les vagabonds et les vulgaires coureurs d'aventures.

Les témoignages du temps sont unanimes à constater l'état moral admirable de la population.

Un trait qui fait bien voir que nos premiers habitants étaient des colons " sérieux ", c'est que les terres qu'ils occupèrent en arrivant sont presque invariablement restées en leur possession. Encore aujourd'hui, la bonne moitié d'entre elles appartiennent à leurs descendants. Ce n'est pas là le caractère d'un peuple qui s'assemble par hasard sur un coin du globe, et qui se disperse parce qu'il n'a aucun but élevé dans la vie. Consultez l'histoire des établissements de toute l'Amérique, nord et sud, îles et continent, vous serez étonnés de voir combien de couches différentes de population il a fallu pour peupler définitivement les meilleures terres : au premier vent du caprice, les aventuriers prenaient leur vol. Ici, on savait pourquoi l'on avait quitté la France, sur qui on pouvait compter dans le malheur, et, comme on avait été élevé dans le travail des champs, non dans les faubourgs des villes, on poursuivait sa carrière sans fléchir, sans rêver de mines d'or ou de diamants, sans manquer au devoir.

Un écrivain étranger me disait un jour : — N'allez pas prendre en mauvaise part la croyance que je me suis formée sur vos origines ; il n'y a pas de honte à penser que des chenapans se sont faufilés parmi vos premiers colons ; cela s'est vu dans toutes les colonies.

— Mais, lui ai-je répondu, voilà précisément le point de la question ; ces choses n'ont pas eu lieu chez nous ; je maintiens derechef que nous présentons une exception, et alors vous êtes tenu de me fournir des preuves. Les suppositions sont ici hors de place.

Tant que nous n'aurons rien découvert de plus que ce qui est à présent dans la main des amateurs de l'histoire du Canada, les étrangers commettront une injustice en disant que nos origines sont entachées " comme celles de toutes les colonies."

Depuis un demi-siècle que l'on pioche pour trouver matière à un tel acte d'accusation, il n'est sorti de l'ombre du passé que des documents en notre faveur. Piochez, Messieurs, piochez encore !

III

Avec les années 1663-1682 se présente la question du choix des jeunes filles envoyées dans la colonie pour s'y marier. C'est ici le cas de dire que d'un mot on a fait une phrase, de cette phrase un chapitre, de ce chapitre un volume. Recherchons la source des calomnies publiées à ce sujet.

Le baron de La Hontan, venu au Canada comme officier dans les troupes, dix ou douze années après l'arrivée des dernières jeunes filles adressées de France sous l'administration de Colbert, écrivit des lettres datées de Québec, de Boucherville, de Montréal, du pays des grands lacs, des bords du Mississipi, à mesure qu'il avançait au centre du continent, et sut mêler à nombre de vérités et d'observations justes, des fantaisies, des traits d'imagination tout à fait dans le goût épistolaire de son époque, afin de piquer la curiosité de ses lecteurs. J'ai remarqué ceci : La Hontan ne se livre à ces écarts de cerveau que pour parler de choses qu'il n'a pas vues. Ainsi, rien n'est plus fidèle que certaines descriptions des us et coutumes des Canadiens au milieu desquels il a vécu ; mais, tout à côté, s'il aborde les événements qui datent de dix ou quinze ou vingt ans avant lui, il s'égare invariablement — comme le font encore tous les jours les touristes qui nous visitent et qui vont par le monde racontant des insanités sur les hommes et les choses du Canada d'il y a trois lustres.

Au cours d'une de ses lettres, La Hontan s'est amusé à dire que, autrefois, pour peupler la colonie, on enlevait de Paris des femmes de réputation douteuse, que l'on mariait aussitôt débarquées à Québec. Sur ce thème léger, un garçon d'esprit n'est pas en peine de broder une trentaine de lignes bien croustillantes, — et notre baron n'a pas manqué le coup. Il s'agit de savoir où est la vérité dans tout cela.

L'émigration des femmes et des filles venues avant 1663 ne saurait être celle dont le facétieux officier entretient ses amis. A le lire attentivement, on voit que le mouvement auquel il fait allusion est celui de 1663-72. Or, nous avons, sur la manière dont a été préparée et conduite cette émigration, cent fois plus de renseignements qu'il n'en faut pour confondre La Hontan. J'ai publié là-dessus de nombreux textes accompagnés d'explications sur le caractère de ceux qui dirigeaient alors la colonie, et des observations montrant qu'il est impossible d'admettre dans notre histoire les gens que l'on nous prête si complaisamment.

Mais pour se placer ainsi en contradiction directe avec les faits historiques La Hontan avait-il perdu la tête ? Non. Deux causes le poussaient à se tromper : 1o il ne savait pas un traître mot de l'histoire du Canada ; 2o à la date où il écrivait (1684-87), il se faisait à Paris un raccolage de filles incommodes destinées aux Antilles — et, si vous lisez la correspondance du bon La Fontaine durant ces courtes années, vous en apprendrez des détails édifiants. Ayant donc su, au fond des bois du Canada, comment les Parisiens trai-

taient ces pauvres filles, le capitaine La Hontan voulut se montrer à la hauteur de son siècle en déroulant lui aussi sa petite histoire d'enlèvements et de mariages forcés.

Je le répète, il ignorait l'histoire du Canada entièrement ; il en parle comme un aveugle des couleurs ; sa prose émoustillée s'accorde avec la vérité lorsqu'il décrit ce qu'il a vu ; sur les autres points il bat la campagne.

Les filles envoyées aux Antilles et au Mississipi, de 1682 à 1687, par conséquent après la mort de Colbert, ont eu bien des malheurs. Celles des Antilles se sont vues rejetées et honnies par les planteurs ; celles du Mississipi ont eu le sort de l'infortuné Cavelier de la Salle, chef de l'entreprise. Quelques-unes de ces dernières ont pu gagner la France par la suite.

Les émigrations au Canada étaient organisées autrement, Dieu merci ! Rien d'étonnant si le résultat a été tout autre.

Maintenant, la lettre de La Hontan est-elle la seule pièce de ce genre ? Oui. Des écrivains sont venus plus tard qui ont répété les quelques lignes en question. Répété, comprenons-nous bien ; ce qui n'ajoute rien à leur importance, surtout si l'on tient compte du nombre toujours croissant des pièces historiques de première main que l'on découvre et qui renversent la charge de La Hontan, car c'est tout simplement une charge.

Dans la suite de ces articles, je parlerai des auteurs de lettres ou de mémoires qui, après La Hontan, ont mis en doute la pureté des origines canadiennes : il est nécessaire de prévenir le lecteur que ces nouveaux venus ne s'attachent pas à la période de 1663-72, mais à ce qui s'est passé entre 1697 et 1730. La Hontan est donc le seul qui cherche à jeter du louche sur les personnes choisies par le comité canadien, de concert avec la comité français, pour peupler le Canada (1663-72)—comités qui, on le sait, furent formés sous les meilleurs auspices, obtinrent un succès complet, et ne cessèrent leurs opérations qu'après huit ou neuf années, alors que le roi jugea à propos d'arrêter l'émigration, disant que le Canada devait être en ce moment capable de se suffire à lui-même. Colbert eut voulu continuer ce qui était si parfaitement commencé ; le roi refusa.

Hier encore, lisant les épreuves des *Sentences et Jugements* du Conseil Souverain de Québec, qui vont paraître, imprimés par les soins du gouvernement provincial, je suis tombé sur les décisions et les mesures prises par le bureau du Canada au sujet du choix et du traitement des filles et femmes attirées de France et accusées plus tard par La Hontan. Il y a aussi dans la correspondance manuscrite des gouverneurs de ce temps (déposée à Ottawa) une foule d'explications sur tout cela. Rien de plus paternel, de plus chrétien, de plus digne de respect que les précautions de nos administrateurs dans tout le cours de cette affaire. Quand on a suivi l'histoire du temps et lu les détails que je mentionne ici, on est tout abasourdi de rencontrer la lettre de La Hontan.

Vingt-cinq ou trente ans après le passage de La Hontan chez nous, on jouait à Paris une petite pièce de théâtre intitulée : *Les mariages au Canada.* Comme il arrive toujours, le second ouvrier ajouta aux défauts du premier. Cette fois, non satisfait de répéter les badinages de La Hontan, l'auteur y met du sien. Il fait converser ensemble des personnes qui ne se sont jamais vues, attendu que les unes étaient décédées lorsque les autres sont venues au monde. Dans cette production insensée, un couple nouvellement marié part de Québec pour se rendre sur la terre ou concession qui vient de lui être accordée — mais il faut que ces braves amoureux passent par le Mississipi avant d'arriver au lieu du défrichement ; — et ils sont vêtus de soie et couverts de dentelles pour entreprendre

ce voyage ; — et ils ne possèdent ni hache, ni pelle, ni rien de ce qu'il faut aux gens qui font de la "terre neuve ;" — et ils parlent sérieusement de vivre de poésie, de recommencer le paradis terrestre, etc.

Je reviens à mon point de départ, savoir que, pour justifier sept ou huit écrivains qui ont dit en passant un mot désagréable des filles et des femmes envoyées au Canada sous l'administration de Colbert, il n'y a qu'une seule source : La Hontan.

Celui qui croit au dire de cet officier n'a certainement jamais débrouillé les contes ou les inexactitudes qui gâtent si souvent ses récits ; et j'ajouterai que pour croire à l'assertion de La Hontan sur le point qui nous occupe ici, il faut n'avoir lu ni les manuscrits ni les ouvrages imprimés qui traitent de l'histoire du Canada.

Le texte de La Hontan, colporté aux Etats-Unis et en France, chez des peuples qui ne savent pas le premier mot de notre passé, a été pris au sérieux et il fait autorité !

IV

Nous allons maintenant nous entretenir d'un préjugé répandu contre nous aux Etats-Unis.

Il semble compris chez nos voisins que les *voyageurs* et surtout les *coureurs de bois* canadiens n'étaient pas de la croix de Saint-Louis. Le terme dont on se sert pour les désigner en dit plus qu'un long poème : c'étaient des *outlaws*, autrement dit des condamnés en rupture de ban. Il ne reste qu'un pas à faire pour affirmer que le Canada renfermait une foule de mauvais garnements échappés du bagne, ou quelque chose d'approchant venus de France, tolérés au Canada, et filant leur corde du côté de l'Ouest à la première occasion. J'ai rencontré cette croyance dans des livres américains et parmi plusieurs cercles de lecteurs, qui sont du reste très bienveillants pour nous. C'est le moment de la combattre.

La compagnie des Cent-Associés avait eu la gestion des affaires du Canada depuis trente-sept ans, lorsqu'elle céda ses droits à la compagnie des Indes Occidentales, en 1664. Jusqu'à ce moment, les hommes employés à la traite des fourrures s'étaient recrutés, partie chez nos habitants, partie en France, où un certain nombre de ces derniers retournaient après trois ou quatre années de service.

Ce commerce avait été gêné presque constamment du côté du Haut-Canada, par les guerres des Iroquois ; il en résultait que peu ou point de Canadiens ou de Français ne s'étaient arrêtés dans les immenses territoires qui s'étendent au delà de Montréal, et qu'ils avaient pourtant découverts de bonne heure.

La prise de possession de la compagnie des Indes, coïncidant avec l'arrivée des troupes de France (1665), les Iroquois battirent en retraite, et, non seulement s'écartèrent du Bas-Canada, mais encore laissèrent la voie ouverte à nos courses vers l'Est, le Sud et l'Ouest.

Des engagés, venus directement de France, continuèrent alors la tradition et se répandirent au loin. Toutefois, la masse de ceux qui, à partir de cette date, servirent la compagnie nouvelle étaient des fils d'habitants. Cette jeunesse allait ajouter une curieuse page à notre histoire.

Sans doute la plupart comptaient retourner au foyer domestique, à l'expiration de leur engagement. Un sort tout différent les attendait.

Il y a dans la nature humaine des penchants, des aptitudes, des qualités qui ne se révèlent qu'à la faveur des circonstances, et plus d'un *voyageur*, enfant de la charrue, a senti avec étonnement poindre en lui le goût des aventures et le charme de la vie errante, dont il faisait par surprise l'apprentissage.

Dix années s'écoulèrent. Une classe experte, hardie, vigoureuse, stylée à tous les hasards — celle des *coureurs de bois* — se trouva formée. Chacun de ces hommes manœuvrait à part. Les attaches avec la compagnie se relâchaient. Ce n'étaient plus des engagés, mais des gens libres. Leur domaine était l'inconnu de la prodigieuse Amérique. Ni fleuve ni montagne ne les arrêtaient. Au contraire, un horizon entrevu les entraînait plus loin. Parlant toutes les langues, explorant, chassant, *portageant*, *cabanant*, se battant comme les plus adroits des sauvages, ils fascinaient les tribus par leur témérité, par les récits de la vieille France, par leur gaîté, et ils remplissaient les wigwams du bruit de nos chants populaires. Sentinelles perdues de la race gauloise, ils réunissaient dans leur personne l'amour du merveilleux, les agréments de l'imagination, et cette connaissance des métiers et des industries que l'Europe a toujours regardée comme son principal moyen de conquête sur les barbares. Avec la souplesse du caractère français, ils adoptaient les us et coutumes des nations au milieu desquelles ils passaient.

D'ancienne date déjà, les sauvages fréquentaient les Espagnols et les Anglais, sans avoir pu se façonner à leurs habitudes. La raison en est bien simple : ces peuples ne se transforment pas ; il faut aller à eux ; jamais ils ne viennent à nous. Les Français, seuls des races civilisées, savent devenir au besoin Peaux-Rouges, Hottentots ou Patagons.

Voilà pourquoi, à la dissolution de la Compagnie des Indes (1675), les autorités canadiennes s'inquiétèrent de la tournure des choses, et prirent ombrage du grand nombre de coureurs de bois qui ne réintégraient point leur domicile, malgré les ordres lancés à cet effet.

D'une part, le roi, abolissant le monopole dans les affaires de la traite, rendait la liberté à tous ceux qu'un contrat quelconque avait liés à la Compagnie des Indes ; d'autre part, le Conseil Souverain de Québec, se faisant l'interprète des Canadiens résidant au Bas-Canada, exigeait le retour immédiat des fils des colons partis pour les voyages lointains.

La position ainsi tranchée, il s'opéra une sorte de triage parmi les coureurs de bois. Les uns reprirent les travaux des champs dans leurs paroisses natales ; les autres voulurent qu'on les laissât maîtres de leurs destinées, — et ils ne revinrent pas au bercail. Ceux-ci devaient peser d'un poids considérable dans la balance des événements qui se présentèrent de 1675 à 1760.

L'implantation des idées françaises au milieu des tribus si diverses qui peuplaient l'intérieur du continent eut pour résultat de nous rendre formidables aux yeux des colonies anglaises. De Québec, nous entretenions des rapports avec le pays des sources de l'Ohio, les grands lacs, le Mississipi, le Nord-Ouest, et cela grâce aux coureurs de bois principalement. Chose étrange, le Conseil Souverain intimait sans cesse à ces indisciplinés l'ordre de revenir au pays, et il tirait continuellement avantage de leurs courses et de leur influence chez les sauvages pour consolider le prestige du nom français.

Dès 1680, il y avait huit cents hommes de cette classe dispersés dans l'Etat de New-York, la Pensylvanie, le Maryland, l'Ohio, les Illinois, — et, il faut le dire, leur rôle était immense.

N'indiquaient-ils pas à notre mère patrie la direction à suivre pour l'avenir ? Avec

une pareille avant-garde tout devient possible si le corps de la nation s'agite et marche. On ne bougea aucunement. C'est même à cette heure si propice à nos intérêts que cesse l'envoi des colons de France.

Franchissant tous les obstacles, nos coureurs de bois étaient arrivés aux confins des établissements anglais qu'ils serraient de près, étant en quelque sorte devenus possesseurs d'un vaste territoire qui assurait leur arrière-garde et nous reliait à eux. Cette invasion, comparable à celle qui se voit de nos jours, mais plus efficace, en ce sens que nous prenions un terrain neuf, eût dû être soutenue. On chercha à la restreindre. Ce fut peut-être une faute; malheureusement on en commettait une plus grave en abandonnant tout le Canada à lui-même. Nous entrions dans la voie des sacrifices.

Les restrictions portées contre les coureurs de bois atteignirent l'apogée de la menace vers 1690. On qualifiait ces hommes de tranfuges ; ils ne l'étaient aucunement, et, pour le prouver, ils se fortifièrent de plus en plus dans les contrées envahies. Les Anglais en croyaient à peine leurs yeux. Les indigènes allaient de préférence traiter aux postes français. Les Anglais se plaignirent hautement. Louis XIV frappa d'anathème les braves qui semblaient vouloir lui conquérir l'Amérique tout entière.

Des peines rigides édictées contre les coureurs de bois est sorti, dans le langage de nos voisins, le mot *outlaw*.

Voyant que le monarque français mettait à l'amende et à d'autres risques plus graves ses sujets qui trafiquaient sans sa permission au-delà du territoire canadien, on se croit autorisé à leur infliger un qualificatif outrageant, et à les assimiler aux repris de justice, voire même aux criminels soustraits par évasion à la sévérité des lois. La vérité historique est tout à fait à l'encontre de cette assertion ; mais une fois qu'un mot est adopté, on connaît sa puissance. *Outlaw* vivra longtemps, je le crains.

Une observation avant que de clore ce chapitre.

Renversons les rôles. Supposons que les colons français se fussent cantonnés dans le Bas-Canada sans en sortir ; que les Anglais aient pénétré les premiers au centre du continent, et que, de proche en proche, ils soient arrivés chez nous. Nous nous serions effrayés de leur audace et de la prépondérance qu'ils obtenaient dans les contrées sauvages. Le génie de ces coureurs de bois nous eût étonnés et peut-être mécontentés ; mais je doute que, de nos jours, il eût pu se trouver un historien français capable de leur décocher l'injure.

Plus d'un procès d'histoire a été jugé à la légère. Il est temps de rouvrir les vieilles archives et de remettre les choses en place. Faisons en sorte que, advenant le jour où les Canadiens-français feront sentir leur nombre et leur valeur dans les affaires de l'Amérique, il ne se rencontre plus qu'une seule et juste opinion relativement à leurs origines.

V

Qui de nous n'a entendu dire : " Les Canadiens-français ont du sang sauvage dans les veines ? "

Cette assertion se base, paraîtrait-il, sur les données suivantes : 1o le petit nombre de femmes blanches au commencement de la colonie ; 2o nos rapports fréquents avec les tribus indigènes ; 3o la couleur des cheveux, de la peau et des yeux chez certaines familles canadiennes.

Durant la période de 1608 à 1663, où le nombre des femmes françaises était moindre que celui des hommes, chacun des membres de nos familles a laissé des traces nettement indiquées de sa carrière. Toutes les alliances de ce temps nous sont connues. Pas une personne n'échappe au contrôle de l'histoire. De plus, nous savons quel soin prenaient les gouvernants pour empêcher les mariages mixtes, à cause de la facilité avec laquelle les Français se faisaient sauvages une fois " habitués " avec leurs frères de la forêt. (Les sauvages appelaient les Français leurs frères par amitié.)

Pendant l'intervalle en question, il y a eu sept mariages de Français avec des Huronnes et des Algonquines, par permissions spéciales. Cinq de ces mariages ou laissé des enfants. La population blanche de la colonie était de deux mille cinq cents âmes, en 1663.

Les arrivages si nombreux de colons, hommes et femmes, de 1663 à 1673, établirent une juste proportion entre les deux sexes. On constate quatre mariages mixtes dans le cours de ces dix années, et quatre autres, de 1674 à 1700.

Voilà tout ce que de patientes recherches ont pu nous apprendre. Il est à présumer que nous avons ici le chiffre total de ces unions, durant le dix-septième siècle. Cependant, doublons-le, afin de satisfaire les plus difficiles, et nous arrivons, en l'année 1700, avec trente mariages de ce genre, au milieu d'une population de seize mille âmes. Ce n'est pas la peine de discuter.

Le plus ancien de ces mariages est de 1644, époque de la grande concentration des Algonquins autour de Montréal, Trois-Rivières et Québec, à cause des ravages exercés par les Iroquois dans les territoires de l'Ottawa. La race algonquine, déjà en décadence, fut presque anéantie, trois ou quatre années après. Tout aussitôt, les Hurons, chassés du Haut-Canada, arrivant par petites bandes, se réfugièrent sous les murs de Québec. Ces tristes débris de deux nations autrefois puissantes, formèrent des bourgades, sous la direction du clergé, qui, on peut l'affirmer, pas plus que les autorités civiles, n'encourageait les métissages.

Vers 1680, nous voyons les Abénakis et les Sokokis, autres réfugiés, se grouper à Sillery, Bécancour et Saint-François-du-Lac. Le poste iroquois du saut Saint-Louis et celui (plus mélangé) du lac des Deux-Montagnes, datent aussi de ce moment.

L'administration de ces bourgades était faite avec une sollicitude telle que le moindre individu était surveillé.

D'une part, les campements des nomades n'existaient plus, faute de sauvages ; d'autre part, ce qui survivait de ces peuples habitait en communauté des villages placés sous nos yeux. La ruine des indigènes du Bas-Canada était complète dès 1660 ; les familles qui restaient ne formaient guère qu'une poignée d'individus.

C'est alors que la colonie française prit son essor. Française elle était, française elle resta, car il n'y avait pas assez de femmes sauvages pour épouser la huitième partie de nos garçons, en supposant que la chose fût permise, — ce qui n'est pas soutenable, puisque nous savons qu'elle était défendue.

Je suis très large, par conséquent, en accordant trente mariages mixtes au dix-septième siècle. Il ne m'est permis d'en accepter encore qu'un moindre nombre pour le dix-huitième, vu que les sauvages diminuaient graduellement, et que nous augmentions dans des proportions étonnantes.

Mais, dira-t-on, à part ces alliances reconnues par l'Eglise et l'Etat, il devait y en avoir à la mode des sauvages. Je le crois, c'est probable, c'est même à peu près certain.

Les enfants issus de ces rencontres ne pouvaient pas être Canadiens-français ; ils ont dû suivre leurs mères dans les bois ; ce furent des métis, dont les descendants sont aujourd'hui des sauvages. Au lieu d'avoir sous ce rapport emprunté au sang indigène, nous y avons plutôt mêlé le nôtre, en pure perte.

Parlons des métis, puisque nous y sommes.

Il y a deux cents ans aujourd'hui, les sauvages du Bas-Canada n'avaient plus guère d'importance comme chiffre,— mais il restait des tribus dans le Sud, l'Ouest et le Nord-Ouest. Nos coureurs de bois commencèrent à métisser rondement. Point de femmes blanches dans ces vastes contrées. La galanterie française y brilla sur tous les points. Une race nouvelle vit le jour, tenant le milieu entre la barbarie et la civilisation. Telle est l'origine des *Bois-brulés :* — père français, mère sauvage.

Ces sangs mêlés ne sont pas venus se joindre à nous. Ils occupent encore le pays de leurs ancêtres. Impossible donc de les confondre avec les Canadiens-français.

Si je ne me trompe, les Bois-brulés datent de 1675 ; la principale période de leur création va de 1700 à 1740, et leur développement se calcule depuis la cession du Canada (1760), alors que, abandonnés à eux-mêmes, les Canadiens de l'Ouest firent corps plus que jamais avec les tribus des grandes plaines.

Ai-je bien déterminé les lignes de démarcation qui nous séparent des indigènes ? Historiquement parlant, peut-on me contredire là-dessus ? J'attendrai une réponse avec curiosité.

Reste à parler de la couleur de la peau, des cheveux et des yeux. Ici je n'ai plus besoin de l'histoire. La science d'observation suffit à résoudre ce problème dans tous les pays du monde.

Si nous possédions des renseignements détaillés sur la couleur de chacun des Français originairement établis au Canada, nous serions en mesure de les comparer au point de vue de l'aspect avec leurs descendants ; mais cette ressource faisant défaut, envisageons la chose à la manière des savants.

Depuis notre premier père, des transformations surprenantes ont eu lieu dans la taille et la couleur des hommes. C'est toujours et partout sous l'influence des milieux que ces phénomènes se produisent.

Depuis près de trois siècles, sous un climat si différent de celui de la France, usant d'une nourriture abondante et saine, occupés à des travaux qui exercent immensément les facultés physiques, nous avons acquis une force dont les physiologistes reconnaissent toute la valeur. Notre expansion le prouve suffisamment, n'est-ce pas ?

Dans ces conditions, la peau, les yeux, les cheveux peuvent bien avoir subi quelques changements de couleur. Il suffit des eaux que l'on boit, des émanations du sol, de la composition des légumes.

Expliquez donc pourquoi cette fille est blonde, tandis que sa sœur est brune, et leurs frères châtains, cuivrés, ou très blancs !

Au Canada comme en Europe, on remarque de semblables différences. Là-bas comme ici, les hommes et les femmes sont robustes dans certaines localités, voisines d'un village ou d'une commune où règnent la débilité et la faiblesse physiques. Affaire d'influences locales. Les animaux sont soumis aux mêmes conditions.

Je ne m'attacherai pas à expliquer plus au long cette théorie, car elle est reçue de nos jours par la masse des lecteurs éclairés.

Maintenant, avons-nous des chevelures noires, des yeux noirs, des peaux foncées à l'excès ? Non, assurément non. Pas plus que les autres peuples. J'affirme même que les individus dont les traits de la figure et la coloration rappellent le type sauvage sont rares parmi nous. Dans bien des cas, en remontant à deux ou trois générations, on constate que la couleur n'est plus aussi sombre ; probablement, les petits-fils de ceux d'à présent retourneront à la teinte primitive.

Et j'arrive ainsi à me demander si nous avons réellement des yeux noirs, des peaux bistrées, des coiffures ailes de corbeaux en plus grandes quantités qu'autrefois, proportion gardée avec le chiffre de la population. Celui qui pourra répondre et éclaircir ce doute aura trouvé une parfaite nouveauté.

Et encore, la question ne sera pas résolue, puisqu'il faudra prouver la descendance sauvage ; et ceci ne me semble pas du tout possible, sauf pour des cas exceptionnels.

VI

Dire que le mouvement d'émigration des Français au Canada prit fin aux environs de l'année 1675, alors que la colonie ne comptait guère que sept mille âmes, c'est répéter ce que chacun connaît. Néanmoins, pour nous en tenir à la stricte vérité, ajoutons qu'il est venu plus d'une famille se fixer parmi nous après cette date. Les circonstances du temps expliquent l'ensemble de la question. Par exemple, un marchand de France, consultant ses intérêts personnels, s'établissait dans notre pays ; un cadet, employé des bureaux de là-bas, passait dans la colonie pour y faire un stage, et finissait par s'y marier. Un artisan que l'appât d'un salaire spécial attirait, un homme de profession demandé en un certain moment, adoptaient la Nouvelle-France et faisaient de ce côté de l'océan souches de familles. Des militaires, officiers et soldats, quittaient les drapeaux pour devenir cultivateurs.

Les militaires ! oh ! la belle race que nous leur devons ! "Canadiens, fils de soldats," est un vers chanté avec le plus complet à propos dans nos réunions nationales. Jamais peuple n'a plus justement qualifié ses origines que le peuple canadien-français disant : "Nous sommes fils de laboureurs et de soldats." La charrue et l'épée resplendissent à notre blason. Pauvres, mais vaillants, travailleurs, courageux, ne désespérant jamais, — tel est notre caractère, tant pour autrefois que pour aujourd'hui. Insistons là-dessus, dans toutes les rencontres où il se fait un échange d'arguments sur nos origines. C'est la vérité ; qu'elle demeure connue ; soyons-en toujours fiers !

Les troupes de France avaient été licenciées jusqu'au dernier homme, en 1672. Après cela, il ne nous a pas été envoyé un seul régiment ; mais, pour renouveler les garnisons, le roi nous expédiait de petits détachements qui recevaient l'offre de prendre des terres, à des conditions très favorables. D'année en année, quelques seigneuries se peuplaient de la sorte ; nos Canadiennes épousaient ces nouveaux colons. Si l'on peut affirmer avec certitude que, chez nous, tous les hommes comptaient et qu'il n'y avait pas d'oisifs ni de classe flottante ou indécise, la même chose doit se dire des femmes. A mesure qu'une fille devenait en âge de se marier, elle se casait, et cela avait lieu dans les conditions de son existence même : enfant de la campagne, elle continuait de vivre dans son premier état, et fondait cette population robuste qui a fait notre orgueil.

Lorsque après la mort de Colbert (c'est-à-dire de 1683 à 1715), Louis XIV, engagé

dans ses longues guerres, négligeait de secourir le Canada, des plaintes partaient du Conseil Souverain de Québec. Nous demandions des hommes à la vieille France pour créer en Amérique une France nouvelle. Le roi répondait à ces justes demandes par l'offre de quelques condamnés, faux monnayeurs, banqueroutiers, vagabonds, traîneurs de rues, galériens. Jamais nous n'avons accepté de pareils cadeaux. Les lettres du monarque, celles de ses ministres existent, et il est vrai qu'on peut les citer ; mais qui nous prouvera que les Canadiens les aient endossées ? Traditionnellement l'esprit de notre population s'opposait à cette classe de gens. Aussi l'avons-nous repoussée ! "Pas de tête plutôt qu'une souillure au front !"

Voyant l'impossibilité de nous imposer les rebuts du royaume, le ministère se rabattit sur les contrebandiers et les faux-sauniers. En ces temps de guerre à outrance, de crises financières, de pauvreté générale (la fin du règne de Louis XIV), un contrebandier était une sorte de gentilhomme, né du peuple, sacré par le malheur, et tout à fait comparable à ce que nous appelons de nos jours "la loyale opposition de Sa Majesté." Les faux-sauniers faisaient pour leur compte le commerce du sel, en dépit des ordonnances. La mère-patrie tirait la langue à ce point que le revenu des taxes sur le sel devenait l'une des grandes ressources du trésor. Lisez Vauban, et frémissez au récit des misères du peuple français. Les contrebandiers et les faux-sauniers de 1693 à 1730, loin de mériter la réprobation de l'histoire, ont droit à nos égards. Eh bien ! le Conseil Souverain de Québec demanda des contrebandiers et des faux-sauniers. Il n'eut pas peur des mots. Il connaissait le monde dont se composaient ces misérables ; il les appelait à lui de préférence aux aventuriers des grandes villes. Laissons les écrivains qui ne comprennent rien à ceci s'effaroucher immensément et prétendre que de telles recrues devaient nous gâter. C'était au contraire un sang généreux qui s'infiltrait dans nos veines.

Alors, me direz-vous, l'incurie de l'administration française ayant donné naissance à toute une classe révoltée contre les lois, le Canada s'est peuplé de ces gens.

Ne dépassons point la réalité. D'après tous les renseignements que nous possédons, il n'est pas venu ici plus de deux cents de ces transportés, durant l'époque en question, soit de 1700 à 1730. Et notez que notre population était en ce moment assise, formée, organisée de longue date. Les nouveaux colons se trouvaient être une goutte d'eau dans un fleuve.

Mais ils sont venus ; je les accepte. Ce que je n'accepte pas, c'est l'accusation d'avoir été gâtés par eux. Ils n'étaient ni assez nombreux ni assez corrompus pour exercer sur nous une influence néfaste. Nous les avons absorbés, tout en retenant peut-être un peu de leur esprit d'opposition au pouvoir,—ce qui n'est pas un mal.

J'ai déjà parlé de Le Sage. L'auteur de *Gil Blas* ne savait pas grand'chose du Canada. Les fantaisies du capitaine Beauchêne l'ont mis en verve à notre sujet. C'était en 1710 et 1715. Beauchêne a plutôt vécu sur la mer que sur le continent. Son histoire est de beaucoup plus particulière aux Antilles qu'au Bas-Canada. Le Sage confondait les tropiques avec le septentrion, — à la mode du bon La Fontaine. Ce que Beauchêne lui a raconté des fils de famille exilés parmi nous, de 1690 à 1715, est en partie vrai, mais quelle surcharge, mon Dieu ! Pour dix gentilshommes que des lettres de cachet ont relégués dans nos postes de traite, Le Sage a l'air de dire que la France avait été dépeuplée, vidée, récurée, nettoyée, déchargée, consolée ! C'est trop de propreté à la fois. A la même époque, un ministre du roi répondait sur une demande d'expatriation forcée : "Nous n'envoyons personne par con-

trainte en Amérique." Et d'ailleurs où prendre les traces de ces pauvres diables dans les généalogies si complètes de nos familles ?

Lorsque Louis XIV mourut (1715), le malaise des finances tourna en catastrophe. Law parut. Brouillant tout, réglant tout, il fit une banque à sa façon. Banqueroute sur toute la ligne, vers 1720. Nous en avons payé cher l'expérience. Le régent répudia presque toute la dette du Canada. Des millions ! Mais il acheta un diamant qui a fait sa gloire ! Une nouvelle compagnie de traite, un autre monopole vit le jour. Cela recommençait plus mal encore. Qu'il se soit introduit alors au Canada des manipulateurs véreux dans les affaires du commerce, c'est croyable. Les détails nous manquent parfois. Je prends l'ensemble des événements, et j'adopte l'idée d'un très pénible état de choses. L'administration de la colonie, concentrée étroitement dans la main du cabinet de Versailles, a dû produire chez nous plus d'un mécompte.

M. l'abbé de la Tour, qui a passé deux ou trois ans à Québec vers 1730, dit, sans distinguer la moindre nuance et sans fixer aucune date, que le Canada s'est formé de gens ruinés et compromis en France. Il était aussi peu instruit que La Hontan, qui, avant lui, avait exercé sa causticité sur les filles choisies par Colbert. L'abbé de la Tour parle évidemment de ce qui s'est passé de 1715 à 1730 ; et, en bonne raison, ce n'est pas là la période du peuplement du Canada. Quelques individus, hommes de bourse ou autres, ont mis en ce moment-là le désordre dans le commerce du pays ; voilà tout. Ils n'ont probablement pas ajouté une seule famille à notre population. Ne confondons plus autour avec alentour, ou avec la Tour.

Après 1672, les émigrants ne sont pas venus en nombre. A quoi bon se figurer que les petits groupes isolés de contrebandiers, de soldats, de faux-sauniers, de commis de banque, de cadets tapageurs, ont imprimé leur caractère à notre peuple ? Les faits historiques sont là qui démentent ces suppositions. Notre existence comme peuple ou nation était faite. Le cadre était tracé. Nous existions. Nous dominions par le nombre. La volonté des Canadiens était la loi suprême dans l'ordre moral. Un aventurier de plus ou de moins ne changeait rien à notre situation. Pas plus qu'aujourd'hui. Et, comme l'écrivait Pierre Boucher en 1663, " on sait aussi bien pendre au Canada qu'en France." On savait fouetter pareillement, marquer au fer rouge, mettre au pilori. Les vauriens retrouvaient ici les mêmes douceurs qu'en Europe. Une loi ferme bien appliquée, c'est une page d'histoire.

Le sieur Lebeau, qui fut enlevé de Paris, par ordre supérieur en 1729, avec quinze ou seize de ses pareils, et débarqué à Québec, tant bien que mal, raconte que M. de Beauharnois, gouverneur général, les voyant arriver, et connaissant que ce n'était point là un choix d'hommes désirables, s'exclama : " Vos parents et ceux qui vous ont envoyés en ce pays ont perdu la tête ! " Ces jeunes gens étaient impropres aux travaux de la colonie ; ils devenaient un embarras ; on en fit entrer quelques-uns dans les troupes ; un autre devint teneur de livres ; ceux-là maîtres d'école ; ceux-ci barbiers, etc. Puisque l'événement surprit et indigna le gouverneur et l'évêque au point que nous dit Lebeau, j'en conclus qu'il n'était pas dans les coutumes.

L'histoire de la Louisiane de la même époque (1715-1745) nous enseigne que deux partis luttaient l'un contre l'autre dans cette province : les Français et les Canadiens, Bienville et Vaudreuil, deux Canadiens, gouverneurs de la Louisiane durant ces trente années, étaient sans cesse accusés de soutenir le parti canadien, que les commissaires et

les marchands français qualifiaient de canaille et d'écume du Canada. Les antipathies des auteurs de ces accusations sont visibles ; d'un autre côté, Bienville et Vaudreuil ne ménageaient guère les Français. Ces derniers avaient mis pied à terre sur les bords du Mississipi dans des conditions bien autrement louches que les Canadiens.

VII

De 1730 à 1744, personne ne saurait nous dire comment s'est faite l'émigration des Français au Canada, pour la bonne raison qu'il n'y en eut aucune—sauf que les troupes continuèrent à y recevoir des congés et à prendre des terres,—et encore en bien petit nombre : tout au plus vingt par année. De 1744 à 1760, ce fut une guerre continuelle. Toute notre histoire est alors comprise dans celle des batailles, des marches armées, des disettes, des malheurs innombrables qui annonçaient la conquête. Ainsi n'en parlons pas.

Je me suis cru tenu de rappeler phase par phase les mouvements qui marquent le peuplement du Bas-Canada, depuis l'heure des débuts. On peut être certain que je n'ai rien caché ni rien exagéré. Il ressort d'un examen attentif du sujet que la masse principale des témoignages nous est favorable, et que les rares voix contradictoires, qui se rencontrent au cours du temps, ne comportent pas le caractère de véracité et d'exactitude indispensable pour former l'opinion de l'historien.

Aimons néanmoins que l'on nous attaque ; cela nous permet de faire un retour avantageux vers le passé.

III — *Lettre d'un volontaire du 9e voltigeurs campé à Calgary,*

Par A.-B. ROUTHIER.

(Lu le 27 mai 1885.)

Depuis un mois déjà, père, je suis soldat ;
Et vous aviez raison, en m'enseignant l'histoire,
De me dire souvent que c'est un noble état.
Tout dans notre métier n'est-il pas méritoire ?

Je n'étais qu'un enfant quand je vous ai quitté ;
Mais rien ne fait grandir comme le port des armes.
Je me sens maintenant un homme, en vérité :
Soyez fière de moi, mère, et séchez vos larmes.
De nous plaindre du sort nous n'avons pas le droit.
Certes nous avons eu de bien rudes journées ;
Nous avons bien souffert de la faim et du froid,
Et nos épreuves sont loin d'être terminées :
Campement dans la boue, à la pluie, au soleil,
Jours de marche forcée à travers la prairie,
Jeûnes, privations, longues nuits sans sommeil...
Mais tout nous est léger, car c'est pour la patrie !

Il est nuit, et j'écris à la lueur des feux,
Où brûle un peu de tourbe et d'herbes desséchées.
Le camp offre un aspect pittoresque et joyeux :
Sur un lit de gazon nos tentes sont dressées ;
Et sur leurs cônes blancs les ombres des soldats
Passent en vacillant comme de noirs fantômes.
Dans ma tente on se livre à de bruyants débats
Sur les hommes de guerre et les puissants royaumes ;
Et, quand on a réglé le sort des nations,
Un sujet toujours neuf revient troubler le calme
Et ranime bientôt d'âpres discussions :
Chacun vante sa belle... et décerner la palme
Est chose périlleuse entre de tels guerriers :
Ces héros de vingt ans sont de preux chevaliers.

Quand ils ont raconté toutes leurs aventures,
Et sur un ton lyrique exalté leurs amours,
Ils combinent entre eux leurs prouesses futures :

Ils vont exterminer *Bonnet-Blanc* et *Gros-Ours*
Et se faire un trophée avec leurs chevelures.

Ailleurs, ce sont des jeux, des rires et du chant.
A deux pas un jeune homme à la voix sympathique,
La tête basse, chante *Un Canadien errant ;*
Et plus loin tout un chœur entonne un vieux cantique.

Aux flammes du bivouac nos faisceaux radieux
Jettent des reflets clairs dans la nuit étoilée ;
Et là-bas les glaciers des grands monts sourcilleux
Blanchissent l'horizon de neige immaculée.

Ce spectacle est très beau, mais triste en même temps.
Je ne sais quoi de lourd plane ici dans l'espace ;
La prairie a l'air traître, et me dit, quand j'entends
Un galop de cheval : c'est un Caïn qui passe !
On sent courir dans l'air des frissons inconnus.
Les Indiens sont muets et leurs regards sont louches ;
Nous sômmes loin ici d'être les bienvenus,
Et de la plaine on voit surgir des chefs farouches.

Parfois, lorsque le camp s'endort silencieux,
Mon regard tout rêveur, plein de mélancolie,
Va se perdre à travers l'immensité des cieux ;
Et dans les astres d'or je crois voir — ô folie ! —
Etinceler les yeux de ceux qui ne sont plus.
Ils m'attendent peut-être... ils sont heureux sans doute,
Et vers cette patrie où trônent les élus,
Dans la plaine céleste ils m'indiquent la route.
Quand la triste nouvelle en nos rangs circula
Que la mort décimait nos braves volontaires,
Tous, nous nous sommes dit : Ah ! que n'étions-nous là,
Pour partager le sort de nos valeureux frères !

D'autres fois mes regards descendant des hauteurs
S'élancent au-delà des solitudes mornes,
Et dans mes yeux soudain je sens monter des pleurs.
Qu'est-ce donc qui m'émeut ? Dans ces plaines sans bornes
Ai-je donc aperçu quelque fier ennemi ?
Non, c'est le sol natal que mon regard contemple ;
C'est mon cher vieux Québec dans ses murs endormi ;
C'est le toit paternel, c'est le clocher du temple,
C'est la pauvre mansarde où travaille un ami.

Mais il ne convient pas qu'un vaillant volontaire
Se laisse efféminer par un doux souvenir :
On m'accuserait d'être un mauvais militaire.
Adieu, père ! adieu, mère ! il est temps de finir...
Et pourtant, je voudrais vous parler d'autre chose.
Il paraît qu'un journal d'une grande cité
En termes méprisants sur notre compte glose,
Et jette des soupçons sur notre loyauté.
Qu'ils sont coupables ceux qui pour servir leur cause
Nous font cette blessure ! Allez, je les connais,
Ceux qui dans leurs journaux nous prodiguent l'insulte,
Après un bon dîner, les pieds sur leurs chenets !
C'est que de la patrie ils ignorent le culte.
Lorsque, fiers de répondre à l'appel du devoir
Qui dans notre chemin comme un grand phare brille,
Nous avons sans faiblir — tout Québec l'a pu voir —
Quitté le lieu natal, le foyer, la famille,
On vient ainsi jeter l'injure à notre front !
A l'heure où nous courons exposer notre vie,
A la peine, au danger, on ajoute l'affront !
Ah ! cette œuvre est ignoble et révèle l'envie ;
Mais l'honneur du soldat n'en sera pas souillé.
Depuis quand donc les fils des héros qu'on vénère,
Et qui pour leur drapeau mouraient à Châteauguay,
Ont-ils démérité d'Albion notre mère ?
Quel est donc le devoir qu'ils n'ont pas su remplir ?

Sans doute ce n'est pas une œuvre de vengeance
Que nous venons ici par le fer accomplir ;
C'est une œuvre de paix, et si notre présence
Dans ce pays troublé suffit à l'établir,
Tant mieux ! car nous n'avons nul désir de répandre
Un sang que nous sentons dans nos veines couler.
Mais si, jusqu'à la fin, sans vouloir nous entendre,
Nos frères de l'Ouest se laissent aveugler,
Nos bras se lèveront au nom de la justice,
Et, frappant à regret ce peuple révolté,
Nous offrirons à Dieu son sang en sacrifice
Pour le salut de l'ordre et de la liberté.

Faut-il pour les métis ne respirer que haine,
Et pour être loyal avoir soif de leur sang ?
Faut-il les accabler d'une guerre inhumaine,
Et sur ces malheureux jeter un joug pesant ?
Non certes, ils ont droit à notre bienveillance ;

Et, si nos troupes vont coucher dans son cercueil
Cette race meurtrie et pleine de vaillance,
La patrie avec nous voudra porter son deuil !
Notre âme peut souffrir sans en être flétrie,
Et sans jamais manquer au devoir d'obéir.
Que la trompette sonne... et pour notre patrie
Nos détracteurs verront que nous savons mourir !

O père, dites-moi quel émouvant mystère
Est dans ce mot " patrie ! " Et qu'il est grand ce nom,
Puisque pour son salut on voit le militaire
Livrer son existence en pâture au canon !

Plusieurs de nous là-bas ont dû quitter leurs femmes,
Leurs mères sans soutiens, leurs enfants sans secours ;
Tous sont pleins de courage et se croiraient infâmes
Si devant le danger ils épargnaient leurs jours...
Mais pour leurs toits déserts c'est un avenir sombre.
Citoyens de Québec, le devoir et l'honneur
Vous conduiront demain dans leurs logis pleins d'ombre,
Et vous y répandrez un rayon de bonheur.

La charité chez vous n'est pas vertu nouvelle ;
Depuis longtemps déjà vous en êtes épris ;
Mais dans ce temps d'épreuve elle est doublement belle,
Car au patriotisme elle emprunte un grand prix.

Déjà sous quelques toits la guerre a fait des veuves ;
Elle fera bientôt de nombreux orphelins :
Que votre charité croisse avec les épreuves !
Pitié pour les petits errant sur les chemins !

Et pendant ce temps-là, loyaux à nos bannières,
Nous combattrons pour l'ordre et pour l'autorité ;
Nous défendrons le faible, et parmi les chaumières
Rétablirons la paix et la sécurité !

Dieu voyage avec nous — le camp a sa chapelle ; —
Sa voix trouve un écho dans notre chapelain ;
Et, si loin du pays, la messe nous rappelle
Tous les chers souvenirs dont notre cœur est plein.
Il nous semble revoir la vieille basilique,
Où le jour du départ, comme d'autres Dunois,
Nous allions, animés par la foi catholique,
Prier le Dieu des forts de bénir nos exploits.

Nous revoyons nos sœurs, nos mères et nos belles,
Les mains jointes, priant pour nous avec ferveur,
Sous leurs voiles cachant quelques larmes rebelles,
Et nous suivant de loin et des yeux et du cœur...

Je m'attendris encore... Allons, je vous embrasse
Tous, mon père, ma mère, et mes sœurs tendrement.
Et... si vous rencontrez le soir sur la terrasse
Une brune à l'œil noir cheminant tristement,
Et vous interrogeant du regard... c'est la mienne !
Dites-lui qu'oublier un soldat serait mal ;
Que je me souviens d'elle, et qu'elle se souvienne ;
Surtout que je ne veux avoir aucun rival !

IV— *Un des oubliés de notre histoire* —

LE CAPITAINE DE VAISSEAU VAUQUELAIN,

Par FAUCHER DE SAINT-MAURICE

(Lu le 27 mai 1885.)

Où sont aujourd'hui ces héros oubliés qui ont vécu, travaillé, souffert sur ce sol béni et si disputé de la Nouvelle-France ? Leurs heures d'angoisses sont passées. Nous jouissons de la paix qu'ils nous ont donnée. Les neiges, les fleurs, les moissons, les feuilles mortes ont repris leurs droits sur les tombes de ces glorieux inconnus.

Qui songe maintenant à ces morts ?

Quelques chercheurs, quelques rares énamourés des faits et gestes du vieux temps.

Pour les jouteurs, pour ceux qui sont pris à bras le corps avec la question sans cesse renaissante du pain quotidien, Jacques Cartier, Champlain, de Laval, Frontenac, de la Galissonnière, Montcalm, Bougainville, Vaudreuil, restent seuls comme les grands phares dressés devant le peuple canadien, pour éclairer la route française.

Mais les humbles, les petits, qui s'en souvient ?

Demandez à tel homme d'esprit, de cœur, à cet homme qui n'est jamais plus heureux que lorsqu'il parle haut et ferme de son pays et de sa race, ce qu'était le capitaine d'artillerie de Fiédemont. Il hésitera. Il aura une vague réminiscence d'avoir vu ce nom quelque part ; et l'effort de mémoire sera fait.

Pourtant cet artilleur avait une fière âme. La bataille des Plaines d'Abraham venait d'avoir lieu. Depuis quelques heures, le général marquis de Montcalm reposait, glorieux, dans la fosse que lui avait creusée une bombe. Québec en proie aux horreurs de la faim et de la destruction, agonisait. Un conseil de guerre siégeait au château Saint-Louis.

— Nous sommes forcés de capituler, disaient à tour de rôle les officiers réunis en conseil de guerre.

— Il faut prendre une résolution, répondait le plus grand nombre.

Le président se lève et appelle le plus jeune des officiers présents à se prononcer.

C'est le capitaine de Fiédemont.

— On manque de vivres, lui répond cet officier. Les fortifications dont le ministre de la guerre a ordonné la construction sont à peine commencées, soit. Quant à moi, j'ai encore de la poudre et des boulets. Si Québec doit mourir, m'est avis que Québec doit mourir comme il a vécu, par la poudre. Défendons-nous jusqu'à la dernière extrémité, et quand nous aurons tiré notre dernière bombe, notre dernier boulet, je réponds qu'il restera encore assez de poudre pour nous permettre de nous ensevelir sous le drapeau.

La mémoire d'un pareil homme peut-elle s'oublier ?

Et celle du marquis d'Aiguebelles ?

Qui se souvient aujourd'hui de ce brillant officier, se lançant à la tête de ses cinq compagnies de grenadiers de France, reprenant trois fois le moulin Dumont aux montagnards écossais pendant la bataille de Sainte-Foye, et restant debout, plein de voix, de courage, d'élan, au milieu de ses troupes balayées par les vingt-deux bouches à feu de l'ennemi ?

Qui connaît le nom du brave de la Roche-Beaucourt, courant à la tête de ses cent chevaux porter des sacs de biscuit et ravitailler Québec isolé, le lendemain de la bataille des Plaines d'Abraham ? Quels sont les souvenirs éveillés maintenant chez le peuple par les noms du jésuite De Quen, le découvreur du Lac Saint-Jean, de Couture et de Saint-Simon prenant possession de la Baie d'Hudson au nom du roi de France, de Saint-Lusson qui en fait autant pour le pays des Outaouais, de Du Mantet, de Courtemanche, de La Perrière, de Saint-Ovide, de Subercase, le héros de Terreneuve, de Dalquier, qui a décidé du sort de la bataille de Sainte-Foye, de Dumas, de Poulariés, du marquis d'Albergotti-Veza, de Bourlamarque, de Sennezergue, de Saint-Ours, blessé mortellement aux Plaines d'Abraham, de Rhéaume, qui a donné son sang à la Nouvelle-France ? Qui a conservé le souvenir de ces nobles âmes qui ont fait pleurer et qui ont honoré la patrie lorsqu'elles sont remontées vers Dieu ? Quelques livres écrits par de modestes savants chez qui brûle la flamme vive du souvenir, cette lampe que les vivants allument pour honorer les morts.

Il est bon de rappeler la mémoire de ceux qui ne sont plus et qui ont aimé leur pays. Je me joins à ces chercheurs ; et à mon tour je viens aujourd'hui vous parler d'un de nos grands oubliés. Je veux vous raconter une vie qui n'a été qu'une série d'actes de courage, de dévouement, et de déceptions.

Lors de l'un de mes voyages en France, le hasard m'a fait trouver un curieux ouvrage où l'on parlait incidemment d'un jeune officier de la marine. J'ai comparé ces renseignements avec ceux que renferment les précieux documents historiques qui ont été colligés par nos historiens et par notre gouvernement. C'est ainsi que j'ai pu refaire la vie du capitaine de vaisseau Vauquelain, de cet intrépide officier français qui, le 17 mai 1760, livra sur sa frégate l'*Atalante*, à des navires de guerre anglais, le combat naval de la Pointe-aux-Trembles, près Québec, et qui prit part à toutes les escarmouches qui le précédèrent.

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Fils d'un de ces armateurs dieppois, moitié corsaires moitié marchands, et les meilleurs marins de l'époque, Jean Vauquelain naquit à Dieppe en 1727. [1] Dès l'âge de douze ans il était à bord du navire de son père, et partait pour les Antilles, où pendant six années il fit d'heureuses croisières, se rompant sous l'œil paternel aux rudes travaux de la mer, apprenant la manœuvre, la théorie, la pratique, et formant sa volonté et son esprit à l'art difficile qui désormais avait pris sa vie. Son père se sentait revivre avec orgueil dans ce mousse qui promettait, et une circonstance vint confirmer ses espérances. En 1745, le

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[1] Vauquelain est la véritable manière d'épeler le nom de cet officier, et non pas de Vauclain ou de Vauclin ainsi que le font la plupart des historiens en mentionnant son nom au fil de la plume. Dans son journal du siège de Québec, le capitaine Knox l'appelle toujours *Vauguelin*.

bâtiment qu'il montait fut attaqué par une frégate anglaise. On était, ce jour-là, à la hauteur de la Martinique. L'Anglais était supérieur au Français, en hommes, en canons et en vitesse ; mais le père Vauquelain était un vieux loup de mer, car la chronique du temps ajoute en parlant de lui : " Ce capitaine marchand savait se battre. Tout occupé qu'il fût dans ce combat, où il n'avait que trente-six hommes et douze canons à opposer à une frégate de vingt canons et de quatre-vingts hommes d'équipage, il ne perdit pas pour cela de vue la manière dont son fils se comportait. Et ce père fut plus sensible au sang froid et à la bravoure de ce jeune homme, âgé alors de dix-huit ans, qu'à la gloire d'avoir forcé son ennemi à se retirer."

Pendant cinq ans ces alternatives de courses, de combats, de négoce, d'échanges, se succédèrent, la réussite étant presque toujours du côté de l'armateur dieppois, lorsque la paix fut signée entre la France et l'Angleterre.

Vauquelain avait alors vingt-trois ans : il pouvait commander au long-cours. Une puissante maison de commerce lui vendit un navire, et, jusqu'en 1756, on le voit faire la traite des épices d'Amérique. Cette année-là une nouvelle déclaration de guerre étant survenue, ordre fut donné aux intendants de la marine et aux commissaires des ports d'envoyer au ministère un état des capitaines au long cours prêts, par leur science, leur habileté, leur habitude de la mer, à se mettre efficacement au service du roi.

Vauquelain fut le premier désigné. A vingt-neuf ans il avait le commandement d'une frégate légère.

Ses instructions portaient qu'il devait " aller à la découverte sur les côtes anglaises, y examiner les mouvements de leurs escadres, les routes qu'elles prendraient, et apporter ou rapporter, selon le cas, les paquets qu'on lui remettrait à des hauteurs indiquées."

Il n'y a qu'un marin pour pouvoir se rendre compte des difficultés d'une aussi pénible et délicate consigne. Par tous les temps il faut tenir la mer. Les coups de vent, les brouillards les plus intenses, les ouragans redoutés par les autres camarades sont alors les bienvenus pour le commandant qui taille en pareille besogne. Brumes et tempêtes n'aident-elles pas au hardi capitaine à se défier de l'ennemi, à passer à travers ses lignes sans être signalé, et à mener à bonne fin une mission d'où dépend le sort d'une escadre ou d'un pays ?

Vauquelain avait le génie des déguisements qu'il faut prendre, des manœuvres et des coups d'audace qu'il faut tenter en semblable occurrence.

A peine tenait-il la mer depuis quelque temps, qu'au retour d'une de ses périlleuses croisières, il reçut — par commission — du ministre de la marine, le commandement de l'*Aréthuse*, frégate de trente canons. Elle était attachée à l'escadre chargée de ravitailler et de défendre Louisbourg, menacé par les Anglais.

C'était une commission et non un brevet que venait de recevoir Vauquelain, et voici la différence de ces deux actes royaux. La commission est une lettre de marque qui confère la permission d'aller en course sur les ennemis ; le brevet donne un grade régulier, permanent, et sujet à promotion dans la marine ou dans l'armée. Changer l'une pour l'autre fut le but suprême de la vie de Vauquelain.

Ce hardi marin ne pouvait trouver plus belle occasion pour faire valoir ses qualités. Aussi le voit-on toujours au premier rang pendant cette guerre désastreuse.

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Le 9 juin 1758, l'*Aréthuse* jette l'ancre devant Louisbourg. Vauquelain s'est rappelé son hardi métier d'éclaireur. Sa frégate a passé sans encombre les lignes de l'amiral Boscawen qui croise à l'entrée du port depuis le deux juin. A peine arrivé, le capitaine prend part à toutes les phases, à tous les succès, à tous les revers du siège. Pendant des journées et des nuits entières ce ne sont que des rafales de fer et de mitraille, qui vont de la ville à la flotte et des assiégeants aux assiégés. Tout ce que peut le génie de la guerre et de la destruction est mis en œuvre par les géants qui se trouvent aux prises. Quatre frégates, deux vaisseaux de ligne français sont coulés à l'entrée du port, pour en défendre l'accès. Ainsi l'a voulu le gouverneur, le chevalier de Drucourt.

Et la pluie de fer de passer toujours, de passer sans cesse sur les implacables ennemis. Un projectile tombe dans la sainte-barbe de l'*Entreprenant*, vaisseau de 74. Il saute. Ses débris mettent le feu au *Célèbre* et au *Capricieux*, dont les batteries chargées et sans artilleurs criblent de boulets et la ville et les Anglais.

Nuit et jour on se fusille, on se canonne de part et d'autre. Hièr au soir une bombe a incendié le "grand corps des bâtiments du roy ;" demain, ce sera un boulet rouge qui mettra le feu à l'église, et à quelques jours de là les casernes de la reine brûleront. Bastions, lunettes, redoutes, escarpes, avant-postes, chemins couverts, casemates, tout est écrasé, tordu, brisé, éventré par la mitraille. Elle ne cesse de crépiter, de tout enlever sur son passage et de tomber si dru, qu'à cent vingt-trois ans de distance, visitant les ruines de Louisbourg, avec un officier de la *Galissonnière*, le lieutenant de vaisseau Rouyaud, nous retrouvions l'assiette et les alentours de cette ville morte, couverts de débris de projectiles.

Pendant ces heures terribles, le moral des troupes ne se dément pas un seul instant. Tous rivalisent. La femme du gouverneur, Mme de Ducourt est au premier rang. Chaque jour, aux applaudissements de ceux qui vont se faire tuer pour la France, elle monte, intrépide sur les remparts battus en brèche et tire trois coups de canon, aux endroits les plus exposés.

Bon sang tient de race : et si notre mère patrie a su léguer à l'histoire Jeanne Darc, Jeanne Hachette et les femmes héroïques de la guerre de 1870, notre Nouvelle-France lui a donné à son tour Mme de la Tour, Mlle de Verchères et Mme de Drucourt.

Et, pendant que se déroule ce drame immortel, Vauquelain et l'*Aréthuse* sont partout, sur la rade, dans le port, au large, faisant leur pénible devoir et donnant eux aussi rude besogne à l'Anglais.

Lisez la chronique de ces jours de sang et de deuil. Dans son laconisme militaire elle est plus éloquente que n'importe quel panégyrique. [1]

"Les Anglais, dit-elle, assiégeaient Louisbourg par terre, et la bloquaient par mer. Vauquelain comprit qu'il incommoderait beaucoup l'ennemi, s'il s'embossait dans une baie le long de laquelle il fallait qu'il passât, ainsi que les munitions dont il aurait besoin, pour faire le siège de Louisbourg. Le coup d'œil de ce jeune capitaine était juste, et le feu de sa frégate, embossée à un quart de lieue du rivage, tua beaucoup d'ennemis et retarda leurs opérations. De leur côté les Anglais formèrent une batterie sur la frégate de Vauquelain, qui, pendant quinze jours qu'elle resta dans cette situation dangereuse, fut

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[1] Vide : *Mémoires pour servir à l'histoire de la navigation française*, tome II, p. 40.

renouvelée trois fois d'équipage. Enfin, voyant sa frégate et ses agrès écrasés des boulets et des obus qu'on n'avait cessé de lui tirer, Vauquelain prit le parti de venir se mettre à l'abri de la ville, pour se mettre en ordre."

Le temps pressait pour réparer les avaries de l'*Aréthuse*. On y para tant bien que mal, tout en ne perdant pas son temps, car la chronique continue :

"Nous tirions à mitraille et faisions le plus de bruit que nous pouvions. M. Vauquelain employait tous les moments qu'on l'empêchait de partir d'une façon qui devait nous consoler de ce retardement forcé."

Mais le siège avançait et le gouverneur de Drucourt voyant sa ville se démanteler, ses troupes décimées par le feu de l'ennemi et par la maladie, résolut de donner de ses nouvelles en France. Fine marcheuse, portant toute sa toile à merveille, et commandée par un capitaine ayant fait ses preuves, l'*Aréthuse* fut choisie pour forcer la croisière anglaise.

Pour y parvenir, il fallait attendre le brouillard du nord.

Les brumes de Louisbourg ! Ah ! j'ai respiré leurs âcres senteurs, et je les ai décrites dans mes notes de voyage. [1]

Rien de triste comme cette nuit en plein jour, qui ne permet pas au matelot de distinguer sur le pont à une longueur de main. Autour de lui tout est nuageux, opaque. La mer est là qui confond ses teintes grisâtres avec le ciel fumeux. Sans le monotone clapotis de la vague qui se brise sur le flanc du navire, l'homme à la roue croirait que son capitaine a mis le cap sur le néant.

C'était au milieu de ce chaos que Vauquelain devait s'orienter. Il le fit en maître des choses de la mer, passant avec précaution à travers les épaves des navires sombrés en rade, évitant les bordées d'artillerie tirées au hasard dans la buée épaisse par amis et ennemis, et perçant la flotte anglaise sans qu'elle s'en doutât. Dès que le rideau de brume se fut déchiré brusquement, ainsi qu'il arrive presque toujours dans les parages du Cap Breton, Boscawen vit avec stupeur l'*Aréthuse* filant grand largue à l'horizon et portant fièrement à sa corne d'artimon le pavillon fleurdelysé.

Les *Mémoires chronologiques pour servir à l'histoire de la navigation française* mentionnent ainsi ce qui arriva alors :

" L'amiral anglais, surpris de la hardiesse et de l'exécution de ce dessein, dépêcha les meilleurs voiliers de sa flotte à la poursuite de cette frégate ; mais par la fausse route qu'elle fit la nuit suivante, Vauquelain les mit en défaut, et arriva à Bayonne."

Bien lui en prit, car sa bonne réputation de marin n'aurait pu le soustraire au sort de ses compagnons d'escadre. Quelques jours après le départ de l'*Aréthuse*, les assiégés, la rage dans le cœur, mais se défendant toujours, virent détruire ce qui restait de la flotte française en rade de Louisbourg. Le *Prudent* et le *Bienfaisant* furent amarinés pendant la nuit par six cents Anglais. Le *Prudent* brûla jusqu'à sa ligne de flottaison, pendant que le *Bienfaisant*, traîné à la remorque par l'ennemi, voyait " tomber ses mâts, pendant le trajet, tant il était maltraité par le canon."

Le 26 juillet 1758, onze jours après le départ de l'*Aréthuse*, le rideau tombait sur le premier acte du drame sanglant de la cession de la Nouvelle-France. Louisbourg capitulait, mais, au milieu de tous ces désastres et de ces humiliations, Vauquelain avait réussi à sauver sa frégate et l'honneur de son pavillon.

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[1] Vide : *De tribord à bâbord.*

Causant un jour avec des officiers de la marine française, après la reddition de la ville, l'amiral Boscawen disait :

— Messieurs, je ne sais pas quel est l'habile commandant de l'*Aréthuse* qui m'a échappé. Je gagerais que c'est un routier marchand, car il sait bien son métier. Si l'un de mes capitaines de frégate en eût fait autant, mon premier soin en arrivant en Angleterre, serait de solliciter pour lui un brevet de capitaine de vaisseau.

Une aussi brillante conduite aurait mérité la récompense d'un haut grade dans la marine royale, mais Vauquelain — disons le mot qui a pesé sur toute sa carrière — Vauquelain était roturier. Autre faute grave, il sortait de la marine marchande. Or, à cette époque, un simple cadet se croyait et par sa naissance et par les traditions du noble corps de la marine, au dessus de ce qu'on était convenu d'appeler un *routier marchand.* Quelques titres qu'eût un de ces officiers de fortune à l'obtention d'un brevet d'officier du roi, " le dernier garde de marine eût rougi de le compter au nombre de ses camarades." Ces dures et tristes paroles ne sont pas de moi, elles sont consignées dans les *Mémoires chronologiques pour servir à l'histoire de la marine française.*

De nos jours, Dieu merci, les choses sont changées. Sous Louis XV et Louis XVI, les officiers, disait l'amiral Jurien de la Gravière, étaient des gentilshommes. Ils sont aujourd'hui des gens bien élevés. Ce n'est pas *à peu près,* ajoutait-il finement, c'est *tout à fait* la même chose.

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Au lieu d'être breveté ainsi qu'il le méritait, Vauquelain ne fut donc que commissionné de nouveau. Le ministre plaça sous ses ordres deux frégates, avec mission d'aller vivement à Québec prévenir le gouverneur d'armer et de se préparer à la résistance.

Arrivé à destination, Vauquelain reçut du marquis de Montcalm le commandement de ce qui lui restait de la flottille française devant Québec, c'est-à-dire, à part des deux frégates qu'il amenait de France, le contrôle des bateaux et des brûlots qui seuls étaient en rade.

Avec ses camarades de combats, Vauquelain assiste à toutes les péripéties du deuxième acte du grand drame dont les premières scènes se sont passées à Louisbourg. Avec eux, il a la douleur de voir vingt vaisseaux de ligne, vingt frégates, une multitude de transports, presque toute la flotte anglaise venir jeter l'ancre entre Montmorency et Québec. La nuit, du pont de son navire, il voit les lueurs des villages embrasés de l'Ange-Gardien, de Saint-Joachim, de Château-Richer, de Saint-Nicolas, de Sainte-Croix, de l'Ile d'Orléans. C'est Wolfe qui se venge, d'une manière peu enviable pour sa réputation militaire, du patriotisme de nos habitants, en brûlant, sur un parcours de vingt-trois lieues, quatorze cents maisons. Vauquelain prend part au siège de Québec, assiste à une partie de son bombardement, a la douleur de voir la vieille métropole incendiée par les feux ennemis, et voit tomber cette vieille cathédrale, *alma mater* de l'Amérique du nord, qui portait si fièrement accroché à sa voûte le drapeau amiral de Phipps, enlevé à la nage par Le Moyne de Sainte-Hélène, en un jour de siège et de combat.

Pendant la bataille des Plaines d'Abraham, c'est Vauquelain qui, à la tête d'une partie de ses marins, manœuvre les grosses pièces de siège et engage les batteries anglaises de la Pointe-Lévy.

Quand sonna l'heure déchirante de la capitulation, l'histoire de la marine française dit que Vauquelain " ne voulant pas que ses frégates y fussent comprises, prit le parti d'assembler son monde et de sortir de Québec pour aller les rejoindre. Il fut assez heureux pour s'y rendre en passant dans un endroit qui n'était pas gardé par les ennemis."

Ce fut alors qu'il se choisit un lieu sûr d'hivernage, restant à bord de l'*Atalante*, vivant avec ses hommes comme il pouvait, maintenant quand même ses communications avec le chevalier de Lévis, et surveillant par de fréquentes patrouilles sur le fleuve ce qui se passait à Québec. C'est ainsi que le journal du capitaine John Knox mentionne constamment les alarmes qu'il donne à la garnison anglaise, entr'autres celle du 23 octobre 1759, celle du 24 octobre, celle du 23 novembre et celle du 24 novembre. Le 28 novembre, par une nuit sombre, il va mettre le feu à un navire échoué ; il en tourne les canons du côté des Anglais qui, tout étonnés, reçoivent ces boulets mystérieux, sans se douter que c'est une manière à Vauquelain de leur rappeler l'incendie du *Bienfaisant* de Louisbourg. Dans la nuit du 4 au 5 mai 1760, par un froid de loup, il fait passer un sloop sous les batteries anglaises, qui ne le découvrent que lorsqu'il est hors de portée. Pendant cette même nuit, il travaille à transporter les canons du camp du chevalier de Lévis à la tranchée ouverte devant Québec. Le 9 mai, le sloop de Vauquelain revient de son voyage à la découverte de la flotte attendue. Il repasse bravement et en plein jour sous les batteries anglaises, et vient se rapporter à son commandant.

Le 11 mai, pendant la nuit, ajoute le journal de Knox, tout Québec est réveillé et mis sur pied. " La garnison court aux armes et y reste jusqu'au matin." C'est encore Vauquelain qui pousse une reconnaissance et qui vient d'éviter un coup de canon du *Leostoff*, frégate anglaise, en rade.

Après la victoire française de Sainte-Foye, Vauquelain vint avec la *Pomone* et l'*Atalante* prendre position à l'Anse du Foulon. A tout instant l'une de ces frégates opère des reconnaissances de nuit.

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Pas un des nôtres n'ignore les heures d'angoisses qui s'écoulèrent entre le 28 avril et le 7 juin 1760. Lévis canonnait sans cesse Murray, qui le lui rendait bien. Les Français poussaient le siège avec vigueur, et chaque jour les deux armées s'attendaient à voir une flotte de secours tourner la Pointe-Lévy et donner le Canada à l'Angleterre, ou le sauver encore une fois pour la France.

Le 7 juin, les sentinelles signalent un navire. Quelle couleur va-t-il arborer ? Les assiégés sont sur les remparts ; les assiégeants couvrent toutes les collines d'où ils peuvent voir le signe de l'abandon ou de la délivrance.

Un rouleau monte lentement à la corne d'artimon du navire. Un vigoureux coup donné par le maître timonnier fait déferler le pavillon. Un hourra éclatant est poussé par les soldats de Murray : c'est leur drapeau, c'est l'emblème du *home* et du lion britannique. Lévis n'est pas découragé. Fier, impassible, il attend encore et répond à ce défi par ses canons. Mais d'autres frégates anglaises arrivent à la file ; il faut se rendre à la réalité : la France nous a oubliés. Lévis fait lever le siège et dépêche à Vauquelain

l'ordre de remonter le fleuve. " Il faisait mauvais, dit le journal du siège, et le fleuve ayant été extraordinairement agité toute la nuit," l'estafette ne put rejoindre le capitaine de l'*Atalante.*

Deux navires ennemis, ainsi que je l'ai dit plus haut, venaient d'arriver.

" Au point du jour, un vaisseau de ligne et deux frégates anglaises appareillèrent et se trouvèrent dans un clin d'œil sur nos frégates. Elles prirent chasse. La *Pomone* s'échoue à Sillery. Vauquelain signale alors aux petits bâtiments de s'échouer à l'entrée de la rivière du Cap-Rouge, et lui-même, appuyé par la brise, va en faire autant à la Pointe-aux-Trembles."

Là, pendant deux heures, par le plus beau temps du monde, lorsque les feuilles s'ouvraient au printemps et que le soleil fait verdoyer la campagne, Vauquelain supporte le feu des deux frégates anglaises, leur rendant coups pour coups. Mais ses munitions s'épuisent. L'*Atalante* est désemparée ; les boulets trouent ses œuvres vives, les débris des mâts jonchent le pont, et il ne lui reste plus que son mât d'artimon. Vauquelain y grimpe, cloue son pavillon au tronçon du mât, fait mettre dans les chaloupes les hommes qui sont encore en état de se battre, leur ordonne d'aller rejoindre le général de Lévis, puis lui, morne, le cœur gros, le visage noir de poudre, il vient se coucher au milieu de ses blessés, au pied du drapeau. Il pleure. Tous ses officiers sont tués, son équipage est décimé : il ne lui reste pas une seule gargousse dans la sainte-barbe, et l'Anglais tire toujours sur l'*Atalante.*

Ne dirait-on pas que c'est cet épisode sublime de notre histoire qui, trois quarts de siècle plus tard, inspirait à Alfred de Vigny ces strophes vibrantes et mâles de la *Sérieuse.*

Ecoutez-les, et dites-moi si je me suis trompé :

Ses boulets enchaînés fauchaient des mâts énormes,
Faisaient voler le sang, la poudre et le goudron,
S'enfonçaient dans les bois, comme au cœur des grands ormes
Le coin du bûcheron.

Un brouillard de fumée où la flamme étincelle
L'entourait ; mais le corps brûlé, noir, écharpé,
Elle tournait, roulait et se tordait sous elle
Comme un serpent coupé.

Le soleil s'éclipsa dans l'air plein de bitume ;
Ce jour entier passa dans le feu, dans le bruit ;
Et lorsque la nuit vint, sous cette ardente brume
On ne vit pas la nuit.

Nous étions enfermés comme dans un orage ;
Des deux flottes au loin le canon s'y mêlait ;
On tirait en aveugle à travers le nuage ;
Tout la mer brûlait.

Mais quand le jour se fit, chacun connut son œuvre ;
Tous les vaisseaux flottaient démâtés, et si las
Qu'ils n'avaient plus de force assez pour la manœuvre ;
Mais ma frégate, hélas !

Elle ne voulait plus obéir à son maître;
Mutilée, impuissante, elle allait au hasard,
Sans gouvernail, sans mâts; on n'eût pu reconnaître
La merveille de l'art!

Engloutie à demi, son large pont à peine,
S'affaissant par degrés, se montrait sur les flots;
Et là ne restaient plus, avec moi capitaine,
Que douze matelots.

Je les fis mettre en mer, à bord d'une chaloupe,
Hors de notre eau tournante et de son tourbillon;
Et je revins tout seul me coucher sur la poupe
Au pied du pavillon.

J'aperçus des Anglais les figures livides
Faisant pour s'approcher un inutile effort,
Sur leurs vaisseaux flottant comme des tonneaux vides,
Vaincus par notre mort.

La *Sérieuse* alors semblait à l'agonie,
L'eau dans ses cavités bouillonnait sourdement.
Elle, comme voyant sa carrière finie
Gémit profondément.

Je me sentis pleurer, et ce fut un prodige,
Un mouvement honteux; mais bientôt l'étouffant:
— Nous nous sommes conduits comme il fallait, lui dis-je;
Adieu donc, mon enfant!

Elle plongea d'abord sa poupe et puis sa proue;
Mon pavillon noyé se montrait en dessous:
Puis elle s'enfonça tournant comme une roue,
Et la mer vint sur nous.

La mer, cette tombe glorieuse et silencieuse du marin, ne vint pas sur Vauquelain. Le pavillon fleurdelysé continuait toujours à flotter à l'artimon brisé de l'*Atalante*, et le *Leostoff* et la *Diane* tiraient toujours. Enfin les Anglais se décident à aborder ce mystérieux vaisseau, qui brûle par l'avant. Pas un mouvement ne se fait à bord du navire français: on n'entend que les crépitements de la flamme qui fait lentement son œuvre. Les Anglais grimpent à l'abordage. Ils aperçoivent Vauquelain en grande tenue et sans épée; il l'avait jetée dans le Saint-Laurent pour éviter de la rendre. Le commandant de l'*Atalante* était assis au milieu de ses blessés, au pied du pavillon.

— Pourquoi n'amenez-vous pas vos couleurs, lui demande l'officier anglais?

— Si j'avais eu plus de poudre je causerais encore avec vous, Monsieur, lui répondit fièrement Vauquelain. Quant à mon drapeau, si vous voulez le prendre, vous n'avez qu'à monter le déclouer. Mon devoir de Français est non pas de l'amener, mais de faire amener ceux des ennemis de mon pays.

L'officier qui venait d'amariner l'*Atalante* fit alors embarquer Vauquelain dans sa baleinière, envoya mettre à terre les blessés, et monta lui-même déclouer le pavillon de France.

La frégate française n'avait que seize canons, le vaisseau anglais en portait quarante ; et le combat qu'il eut à soutenir avec l'*Atalante* fut si rude qu'il sombra le lendemain. Outre le *Leostoff*, capitaine Deane, Vauquelain ce jour là avait eu maille à découdre avec le *Vanguard*, commodore Swanton, et la *Diane*, capitaine Schomberg.

Le commodore Swanton reçut Vauquelain à Québec, en héros.

— Je suis tellement émerveillé de votre défense, lui disait ce brave officier supérieur, que je vous prie de me demander sans contrainte, ce qui peut vous être le plus agréable.

Vauquelain lui répondit :

— Ce que je priserais par-dessus tout, commodore, c'est ma liberté et la permission de rentrer en France.

Et les documents anglais de l'époque ajoutent :

" L'amiral considérait si grandement cet officier, qu'il donna l'ordre d'armer de suite un navire pour le mener en Europe, avec ordre au capitaine d'obéir à Vauquelain et de le débarquer dans le port français qui lui plairait. Il lui laissait de plus le choix à faire parmi les Français qu'il désirait voir rapatrier avec lui, sur ce vaisseau."

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Quelle différence entre cette conduite d'un ennemi loyal et la réception que lui fit en France son chef, le ministre de la marine !

La duchesse de Mortemart ayant suivi Vauquelain depuis sa naissance, et connaissant sa valeur, avait recommandé tout particulièrement son protégé à M. de Berryer, secrétaire de la marine.

Celui-ci lui répondit comme un sot et un maroufle qui sent l'escalier de service.

— Madame, lui écrivait-il, je sais que M. Vauquelain a servi le roi avec un zèle et un courage extraordinaires. C'est un héros, mais ce n'est pas un noble, et j'ai une foule de fils de famille qui attendent après des promotions. Il appartenait autrefois à la marine marchande : je lui conseille d'y retourner.

C'était ce même Berryer qui recevait un jour de Bougainville cette bourrade :

Bougainville le suppliait de faire un dernier et suprême effort pour sauver le Canada.

— Et, Monsieur, lui dit le ministre impatienté, quand le feu est à la maison, on ne s'occupe pas des écuries.

— On ne dira pas du moins que vous parlez comme un cheval, lui dit carrément de Bougainville.

Malgré les avis du ministre, Vauquelain obtenait, en 1763, un brevet de lieutenant de vaisseau. Le mémoire auquel j'emprunte ces dates, ajoute :

" Une grande partie de la marine royale ne le vit pas sans peine élevé à ce grade, qui le mettait en rang de parvenir dans les premiers postes.

" M. de Praslin, ministre de la marine, ayant besoin d'un officier capable de s'acquitter d'une commission importante dans les grandes Indes, donna, par commission, le commandement d'un vaisseau de soixante canons à Vauquelain. Ce choix excita encore la jalousie de la marine royale, qui opposa plusieurs obstacles à son départ. Vauquelain en triompha, et sortit de Rochefort pour se rendre aux grandes Indes. Pendant la traversée, cet officier

de fortune essuya les plus grands désagréments de la part des officiers de vaisseaux qu'il commandait. Enfin, il arriva heureusement à Pondichéry, remplit avec distinction sa mission et revint en France l'année suivante.

" M. le duc de Praslin n'était plus alors ministre de la marine, et celui qui lui avait succédé, faute de connaître Vauquelain, ne put se garer des rapports de la calomnie. Dès que ce brave marin eut mis pied à terre, on lui enjoignit de rester aux arrêts dans son appartement. Surpris de cette punition, à proportion de l'applaudissement qu'il comptait recevoir pour s'être acquitté de sa commission avec succès, il eut recours dans sa triste position à la duchesse de Mortemart, digne héritière des vertus comme des terres des gouverneurs de Dieppe. Les sollicitations de la duchesse dessillèrent les yeux du ministre. Après trois à quatre mois de détention, Vauquelain reçut l'ordre qu'on lui rendait sa liberté.

" Le premier usage qu'il crut devoir en faire, fut d'aller à Versailles rendre compte de sa traversée des Indes. Mais avant de partir, la reconnaissance lui fit un devoir de saluer et de remercier plusieurs officiers de marine qui n'avaient point rougi de le visiter dans sa disgrâce. Il sortit à cet effet, sur le soir, et fut trouvé mort le lendemain matin, percé de coups, sans qu'on en ait connu les auteurs."

Ainsi périt, à 37 ans, un homme qui aurait pû faire l'honneur de n'importe quelle marine. Il eut à lutter contre les préjugés de castes, et opposa toujours son dédain, sa force de caractère, ses états de service, son patriotisme sans borne, aux calomnies et aux humiliations qui le suivirent pendant sa trop courte carrière.

Au physique Vauquelain était fort bel homme ; son œil reflétait la douceur et la fermeté. Il avait une figure et une tenue fort agréables, et joignait un courage indomptable à une grande modestie. Ses connaissances nautiques étaient craintes et admirées par ses ennemis, reconnues et admises par toute la marine française.

Voilà en quelques lignes le portrait de cet homme qui fait dire à notre grand historien Garneau :

" Mon vieil aïeul, courbé par l'âge, assis sur la galerie de sa longue maison blanche, perchée au sommet de la butte qui domine la vieille église de Saint-Augustin, nous montrait de sa main tremblante le théâtre du combat naval de l'*Atalante*, avec plusieurs vaisseaux anglais, combat dont il aurait été témoin dans son enfance."

Ce nom obscur de Vauquelain, ne serait-il pas le point de départ de la volonté et des grandes pensées que Garneau a consacré toute sa vie à l'histoire de son pays ?

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Le *Moniteur de la flotte* de 1857, cité par M. Alfred Garneau, raconte un trait touchant du fils de ce marin.

" Il laissa en mourant un fils, Pierre Vauquelain, qui se livra de bonne heure à l'étude de l'histoire et de la géographie de l'Afrique, et qui fut couronné en 1771 par l'académie de Lyon.

" Ce jeune savant vivement recommandé par un brave marin qui avait connue sa famille, le marquis de Vaudreuil, fut admis en 1771, par Turgot, dans les bureaux du mi-

nistère de la marine, où il s'occupa de la rédaction d'un mémoire pour réhabiliter la vie et les travaux de son père. Une circonstance toute fortuite vint assurer le succès de ses démarches.

" En 1775, la reine Marie-Antoinette assista à la première communion des jeunes filles de la commune de Meudon, et, après la cérémonie, l'une d'entre elles, désignée par ses compagnes, lui présenta un magnifique bouquet de roses blanches et lui récita un compliment rédigé d'avance pour la remercier de l'honneur qu'elle daignait faire au pays. La jeune fille chargée de cette démarche était Mlle Elizabeth Vauquelain, alors âgée de seize ans, et qui habitait l'été chez une de ses tantes, à Meudon. Elle plut beaucoup à la reine, qui, après l'avoir embrassée, lui demanda ce qu'elle pouvait faire pour elle.

" La jeune fille sans se déconcerter, et les larmes aux yeux, lui répondit :

" — J'ose demander à Votre Majesté qu'elle fasse rendre justice à la mémoire de mon grand-père.

" Le noble cœur de la reine fut touché de cette réponse.

" Elle embrassa Mlle Vauquelain et lui promit de s'occuper de sa demande. Elle tint parole. Le jour même, elle parla au roi de ce qui venait de se passer. Le roi Louis XVI, toujours juste et bon, ordonna à M. de Sartines, alors ministre de la marine, de faire une enquête sur Jean Vauquelain et de lui en faire connaître le résultat.

" Cette enquête eut lieu immédiatement. Parmi les témoins entendus se trouvaient le célèbre La Pérouse, le marquis de Vaudreuil et les membres de la famille du marquis de Montcalm, le héros du Canada. Elle fut complètement favorable à la mémoire de Vauquelain. Elle établit les glorieux services qu'il avait rendus à la marine et à la France, et l'injustice des accusations dont, vers la fin de sa vie, il avait été l'objet.

" Le roi Louis XVI se fit présenter son fils, et, lui annonçant ce résultat, lui dit qu'il se souviendrait des services de son père. Vauquelain lui remit un exemplaire de son *Mémoire sur la géographie de l'Afrique.* Quelques mois après, le roi lui confia une mission très difficile au Maroc ; il s'en acquitta de la manière la plus satisfaisante. En 1777, la France ayant résolu d'ouvrir des relations suivies avec l'extrême Orient, le roi le nomma son consul en Chine. M. Vauquelain obtint un exequatur de l'empereur Kian-Loung, qui régnait alors. Ce fait depuis ne s'est jamais reproduit. M. Vauquelain a rendu de très grands services et a laissé de très beaux souvenirs en Chine," dans ce mystérieux et riche pays où notre mère patrie promène en ce moment, haut et fier, le drapeau tricolore.

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Voilà, en peu de mots, ce que j'ai pu recueillir sur la vie de ce grand oublié de notre histoire. Pour vous bien faire comprendre cette existence qui fut presque tout entière consacrée au service de notre pays, j'ai dû recourir aux mémoires, aux archives, aux lettres du siècle dernier. En réunissant ces restes épars, j'ose espérer avoir réussi à faire revivre cette énergique figure de Vauquelain, qui, devant son génie de marin, voyait s'incliner sans réplique Anglais comme Français.

Hélas ! Vauquelain n'est pas le seul de nos héros qui soit ignoré aujourd'hui, et peut-être viendrai-je un jour vous raconter les épisodes de la vie maritime de nos compatriotes,

de Le Moyne d'Iberville, du capitaine de vaisseau Claude-Charles Denys de Bonaventure, des deux amiraux de Vaudreuil, des amiraux Bedout et Martin, tous nés au Canada, la majorité à Québec.

Peut-être, à la suite de ces études, vous parlerai-je d'autres marins canadiens-français qui, dans leur humble sphère, ont servi et honoré la France à l'égal de ces grands noms que portèrent nos gouverneurs, les amiraux de la Galissonnière et de la Jonquière. Je ne le cache pas, j'aime ces récits simples, remplis de patriotisme, de poudre, racontant les tours de force maritimes que firent ces illustres marins, et je sens qu'ils ne peuvent manquer de plaire aux descendants de ceux qui y contribuèrent et en prirent leur large part.

Le Nil garde encore l'écho des joyeux chants de rame de nos voyageurs ; et, de nos jours, n'avons-nous pas parmi les nôtres des pilotins, des pilotes, des capitaines au long cours qui sont considérés comme comptant parmi les premiers marins du monde ? Les amiraux Commerell, McClintock, Galibert, Thomasset, Haligon, de Freycinet, le vice-amiral Peyron, ministre de la marine de France, le contre amiral Lacombe, le brave commandant Pottier, du *Bouvet*, se sont plu à le répéter maintes fois à ceux qui recevaient en rade de Québec l'hospitalité de leur bord.

Personne de nous ne s'étonnait de l'unanimité de ces officiers généraux à ce propos, car tous nous nous rappelions que les ancêtres de nos matelots, de nos pilotes et de nos capitaines au long cours, servaient autrefois sous des commandants dont le type se personnifie tout entier dans le mâle caractère de Vauquelain, le héros de Louisbourg et de la Pointe-aux-Trembles.

La mer est ingrate, me direz-vous. La fin prématurée du capitaine de l'*Atalante* en est une preuve. A quoi bon encourager pareille carrière ?

Eh bien, je connais les marins et je les sais par cœur. Si Vauquelain eût vécu, il aurait répondu ce que disait en pareil cas un vice-amiral de France :

— Je suis loin de me plaindre de la Providence. Si j'avais à recommencer une nouvelle existence, je ne choisirais pas une autre profession que celle de la mer. J'ai toujours aimé la marine pour elle-même, et je ne puis revoir la mer sans la saluer avec une sorte de respect. C'est à la mer que j'ai dû mes premières émotions, c'est elle qui m'a fait homme, qui m'a nourri, qui console encore mes vieux jours par les souvenirs qu'elle m'a laissés et qu'elle m'a permis de laisser à ma patrie.

V—*Les derniers seront les premiers.—Hommage à Son Honneur Rodrigue Masson, lieutenant-gouverneur de la province de Québec, Par* PAMPHILE LEMAY.

(Lu le 28 mai 1885)

I

— C'est le nouvel élu, faites grands les passages !
Ecrasez-nous, coursiers, qu'importe ! Ici les sages
Sont les heureux mortels qui vont, galonnés d'or,
De la boue au soleil en un superbe essor.
Les sages, ce sont ceux dont l'orgueil nous écrase ;
Ceux que l'amour du lucre ou des grandeurs embrase ;
Ceux qui, pour se grandir, nous mettent sous leurs pieds,
Qui savent faire rendre aux antiques trépieds
D'iniques jugements ou de douteux oracles,
Qui commandent au ciel de complaisants miracles !...
Passez, courez, volez, attelages fougueux !
Qu'importe ! écrasez-nous, nous qui sommes les gueux !

Ainsi vociférait, au milieu de la foule,
Un homme à l'air sinistre et dur. Comme la houle,
Ou comme les épis que balance le vent,
Les têtes pour le voir se penchaient en avant.

Un vieillard était là. Sa barbe toute blanche
Tombait sur sa poitrine en brillante avalanche,
Comme aurait fait la neige, et, plein d'aménité
Son œil calme semblait sonder l'éternité.
Il s'approcha de moi.

— Cet homme qui blasphème,
C'est le fils d'un maudit, c'est un maudit lui-même,
Un maudit en vertu des lois d'hérédité,
Me dit-il.

J'écoutais avec avidité ;
Il comprit mon désir d'en savoir davantage.
— La malédiction, c'est un triste héritage,
Reprit-il en branlant la tête ; mais celui
Sur qui Dieu fait pleuvoir sa rosée, aujourd'hui,

S'élèvera demain comme s'élève un arbre ;
Et sa gloire vivra plus longtemps que le marbre,
Car il refleurira dans ses enfants cent fois.

II

— C'était, ajouta-t-il, en l'an mil huit cent trois.
Le printemps renouait ses grappes de feuillages
Aux rameaux pleins de sève, et, comme les sillages
Qui découpent le front des océans pourprés,
Le labour tout fumant ridait le front des prés.
Les oiseaux voltigeaient dans la forêt profonde.
Comme une fraîche ondée, à la rive et sur l'onde
Tombaient leurs doux accords.

Ses souliers à la main,
Un pauvre enfant venait sur le bord du chemin.
Il souriait aux fleurs qui rayonnaient dans l'herbe,
A l'oiseau qui chantait sur la cime superbe,
Au ciel plein de clartés, au monde radieux.
Pourtant son cœur saignait beaucoup, et de ses yeux
Des pleurs coulaient souvent qui noyaient son sourire.
Mais il allait toujours, comme s'il eût vu luire
Sur la route inconnue une étoile du ciel.

Il venait de quitter le foyer paternel
Avec sa paix divine et ses chastes ivresses ;
Le foyer que peuplaient les plus douces tendresses,
Où son front d'ange avait reçu tant de baisers.
Il allait, ignorant le monde et ses dangers ;
Il allait désormais, cherchant une demeure,
Vivre de son travail, pour faire un peu meilleure,
A la table modeste, une part à chacun.

Et les fleurs lui versaient leur suave parfum ;
Les ruisseaux, en courant à travers les prairies,
Les bois qui déployaient leurs vertes draperies,
Comme pour adoucir l'excès de ses chagrins,
Chantaient, de toute part, d'harmonieux refrains.

Il s'assit fatigué sur une large pierre,
Essuya de sa main son humide paupière,
Et plongea son regard jusques à l'horizon,
Comme s'il eût encor cherché l'humble maison
Où, douze hivers plus tôt, le ciel l'avait fait naître.

Or, pendant qu'il songeait, essayant de connaître
Ce qu'en ses profondeurs lui cachait l'avenir,
Il vit un beau vieillard sur la route venir.
Et ce vieillard pleurait.

Voir pleurer la vieillesse,
Cela surprend l'enfant et confond sa sagesse.
Dans son âme naïve il croit qu'en ses vieux ans
L'homme plane au-dessus de tous ces maux cuisants
Qui dès les premiers jours troublent son existence.
S'il savait des douleurs l'extrême persistance,
Il voudrait voir sa tombe auprès de son berceau !

Et le vieillard tenait, réunis en faisceau,
Quelques rameaux de houx tout hérissés d'épines.
Courbé sur son bâton taillé dans les racines
D'un âpre cenellier pas encore fleuri,
Il venait à pas lents. Et l'enfant attendri
A l'aspect de cet homme aussi blanc que la neige,
Et l'enfant, tout ému, se leva de son siège,
De son siège de pierre, au bord du long sentier,
Et puis se découvrit, enlevant tout entier,
De son front radieux son frais chapeau de paille.

Le vieillard s'arrêta. Près du petit, sa taille
Semblait celle du chêne à côté de l'ormeau.

— Quel est, demanda-t-il, le plus proche hameau ?

— Du côté d'où je viens, père, c'est Saint-Eustache.
Mais on ne le voit point, la distance le cache.

En répondant ainsi, le jeune voyageur
Regardait sur la route avec un air songeur.

— J'ai faim, reprit le vieux, ma force m'abandonne.

— J'ai du pain, dit l'enfant, prenez, je vous le donne.

Je vais en gagner d'autre en la grande cité...
Ah ! je laisse pourtant avec perplexité,
Pour aller vivre ailleurs, la table de mon père.

Le vieillard prit le pain.

— Ta charité tempère
Le chagrin que tantôt un riche, hélas ! m'a fait,
Et le Seigneur, mon fils, te rendra ce bienfait.

III

Or, pendant qu'il parlait du riche sans entrailles,
Un chasseur jeune et beau s'élança des broussailles,
Et, passant devant lui, fit, par un geste vil,
De sa bouche tomber le pain.

— Maudit soit-il,
Cria le mendiant, celui-là qui se moque
Des pauvres et des vieux ! Et le ciel que j'invoque
De sa lâche action saura bien me venger !

— C'est lui, dit-il encore à l'enfant étranger,
C'est lui qui, tout à l'heure, au lieu d'offrir l'obole
Qu'au nom de Dieu je lui demandais, me dit : " Vole,
C'est votre usage à tous, mendiants paresseux ! "

— Je n'ai plus de vigueur dans mes poignets osseux,
Mais j'ai du cœur encor : je lui crache à la face.
Alors, d'un bras cruel il me fouette sur place,
Avec ses mains d'abord, puis ces branches de houx
Que j'emporte avec moi pour nourrir mon courroux.

Et le chasseur riait d'une façon grossière.
Mais l'enfant ramassa le pain dans la poussière,
Et, l'ayant essuyé, le rendit au vieillard.

Comme un phare s'allume et perce le brouillard,
De l'avenir le pauvre alors perça le voile :

— Va, mon enfant, dit-il, une brillante étoile,
Pour éclairer tes pas, luit dans l'obscurité.
Va, tu seras béni dans ta postérité !

Puis, prenant son bâton pour soutenir sa marche,
Il s'éloigna, semblable au sacré patriarche
Qu'on voyait traverser les siècles d'autrefois.

IV

— Depuis ces jours lointains que rappelle ma voix,
Bien des fois le printemps s'est paré de verdure ;
Bien des fois aux rameaux flétris par la froidure

La neige a suspendu ses éclatants lambeaux ;
Les cloches, bien des fois, sur de sombres tombeaux
Ont versé leur prière et soupiré leurs plaintes,
Et bien des fois aussi les mêmes cloches saintes
Sur des berceaux joyeux ont chanté le bonheur,
Depuis ces jours lointains que rappelle mon cœur.

Et l'enfant a grandi. Sur la terre sa course
Fut semblable au ruisseau qui sort d'une humble source,
Et devient un grand fleuve aux bords ensoleillés.
Et l'enfant a vieilli. Pareil à l'or des blés
Qui couronne les champs dans les jours de l'automne,
La vertu sur son front a placé sa couronne.
Il n'est plus ; il est mort; mais, glorieux destin !
Comme le soleil sort des lueurs du matin,
Et verse sa lumière à torrents sur le monde,
Un fils est né de lui dont la gloire féconde
Inonde son sépulcre !

Et ce fils, le voilà !
C'est le nouvel élu, c'est lui qui passe là ;
C'est lui qu'avec transport un peuple honnête acclame.
Dès qu'il paraît, l'intrigue a peur et rompt sa trame ;
C'est le nouvel élu, le premier d'entre nous ;
Il sait conduire un peuple et prier à genoux !

Et ce gueux en haillons, et ce fripon étrange
Qui l'insulte là-bas et lui jette la fange,
Ce monstre-là, dont l'âme est pleine de noirceur,
C'est le fils dépravé du jeune et beau chasseur,
Du chasseur jeune et beau qui fut inexorable,
Et que maudit un jour le vieillard vénérable !
Les premiers, sachez-le, deviendront les derniers,
Et les derniers seront, dit Jésus, les premiers.

Après qu'il eût cité cette sainte parole,
Le vieillard disparut, comme un oiseau s'envole,
Dans l'air, je ne sais où ...

Je le crois et le dis,
C'était assurément le vieillard de jadis.

VI — *Biographie de Gérin-Lajoie*

FRAGMENT

Par L'ABBÉ CASGRAIN.

(Lu le 27 mai 1885)

On n'a pas oublié le système absurde des capitales alternatives imposé en 1855 par la législature des Canadas unis. Conformément à ce régime, le siège du gouvernement fut de nouveau transféré à Québec en 1859. Cette ville et le Bas-Canada en tirèrent cependant plus d'un avantage.

La présence de la classe d'hommes intelligents, actifs et instruits, qui gravite autour du gouvernement, communiqua à la capitale une impulsion qui s'est accentuée surtout en littérature.

Parmi la population canadienne-française les esprits étaient préparés à ce mouvement. Le haut enseignement qui s'était donné sur divers points, depuis le commencement du siècle, avait répandu le goût des lettres. Il ne fallait que la rencontre de quelques-uns des meilleurs esprits pour créer une révolution intellectuelle. La présence du gouvernement à Québec en devint l'occasion. C'est alors que furent fondées deux revues qui ont fait époque dans nos annales littéraires : les *Soirées canadiennes* et le *Foyer canadien.* Plusieurs des hommes de lettres qui prirent part à la création de ces deux revues étaient attachés au gouvernement.

Aucune idée ne pouvait sourire davantage à Gérin-Lajoie. Il se rappelait l'émulation qu'avait fait naître, au collège de Nicolet, la fondation d'une société littéraire, dont il avait été le principal organisateur, et celle de l'*Institut canadien* de Montréal, à laquelle il avait pris une part si active. Il y voyait le raffermissement de notre nationalité par l'attachement plus ferme à la langue française, et peut-être la naissance d'une littérature canadienne, dont l'idée faisait alors sourire les sceptiques. Dans les discussions assez vives qui se livraient à ce sujet, il répétait souvent avec son vieil ami et son collaborateur, l'abbé Ferland : " Si nous ne pouvons fonder une littérature, nous aurons toujours ce que nous pourrons. N'est-ce pas assez pour donner de l'émulation à tous les vrais Canadiens ? "

Sans doute qu'il ne prévoyait pas, et surtout qu'il n'osait espérer l'immense progrès qui s'est fait depuis, et dont il a été témoin avant de mourir. Il ne prévoyait pas que vingt ans plus tard notre littérature serait un fait accompli, que les auteurs ne se compteraient plus parmi nous, que nos compatriotes d'origine anglaise reconnaîtraient hautement notre supériorité sur ce point, que la France accueillerait cette jeune littérature comme un fleuron de sa couronne intellectuelle, que l'Académie la couronnerait dans la personne du plus français, si ce n'est du plus canadien de nos poètes. Sans voir de si loin, Gérin-Lajoie avait foi dans l'avenir ; et il ne se trompait pas.

Lorsque éclatèrent entre les imprimeurs et les collaborateurs des *Soirées canadiennes* les difficultés qui engagèrent ceux-ci à fonder une nouvelle revue, ce fut Gérin-Lajoie qui fit accepter pour cette publication le nom de *Foyer Canadien*, titre qui dans sa pensée avait une double signification facile à saisir.

Aucun membre du comité de direction, dont il faisait partie, n'y apporta un concours plus constant et plus efficace. Il ne reculait pas devant les tâches les plus ingrates et les plus ennuyeuses, telles que la correction des épreuves et la correspondance, dont le fardeau retombait tout entier sur les directeurs. Sa collaboration nous a valu un des travaux les plus importants qui aient été publiés dans l'une et dans l'autre de ces deux revues, et un des livres les plus franchement canadiens que notre littérature ait produits : *Jean Rivard.*

Les *Mémoires* de Gérin-Lajoie nous livrent le secret de cette conception. N'ayant pu réaliser dans sa vie cet éternel rêve de Cincinnatus à la charrue, dont l'image séduisante fuyait toujours devant lui comme le mirage du désert, il a voulu l'incarner dans une œuvre de prédilection, la revêtir d'une forme tangible dont l'apparition fût une jouissance pour lui-même et un encouragement pour les plus vaillants de ses compatriotes, les défricheurs des bois. Ceux qui ont cherché dans *Jean Rivard* un roman à sensation se sont condamnés d'avance à ne pas le comprendre. L'idée d'écrire un roman n'est pas venue à sa pensée ; il a même eu soin d'en avertir ses lecteurs. Il a voulu simplement mettre en relief le meilleur type du colon canadien, l'homme instruit qui se fait conquérant de la forêt et travailleur du sol.

Les *Mémoires* de Gérin-Lajoie sont remplis de passages où il exprime ses idées sur la culture de la terre, et sa prédilection pour ce genre de vie. L'état d'agriculteur lui semblait le plus normal, le plus rationnel qui soit au monde, celui qui se prête le mieux au développement physique, intellectuel et moral de l'homme. La vie du colon surtout, de ce hardi bûcheron qui commence par s'ouvrir une terre dans les bois, et qui ensuite en tire sa subsistance en enrichissant son pays, lui paraissait grande et noble entre toutes, et digne d'envie.

Gérin-Lajoie, qui avec son patriotisme ardent avait creusé toute sa vie le problème de notre avenir national, avait mieux compris qu'aucun autre l'importance de cette devise des Canadiens-français : *Emparons-nous du sol.* C'est là qu'il voyait la solution du problème. — " Ce travail, disait-il, le plus obscur de la nation, en est le plus fécond. Il n'a de comparable en puissance que celle de la marée montante, calme, invincible, qui envahit ses rivages. Il a reconquis et assuré à la race française une partie du territoire que les armes lui avaient fait perdre. Qui peut dire où il s'arrêtera ? "

Cependant l'admiration et l'attrait que cette rude mais salutaire existence inspirait à Lajoie, le mérite et la dignité qu'il y voyait, ne lui en dissimulaient pas les difficultés, ni les fatigues, ni les misères. Ils les avait approfondies, au contraire, avec cet esprit de réflexion et cette sûreté de jugement qui distinguent ses écrits. Le plus utile de tous les états en est le plus pénible. Aucune classe de notre société n'est plus exposée au découragement, aucune n'est plus souvent délaissée. L'âme sensible et patriotique de Lajoie en était profondément émue, et il s'était bien souvent demandé comment il pourrait apporter sa part de sympathie à cette masse si nombreuse et si intéressante de ses compatriotes ; comment il pourrait leur faire entendre une parole de consolation et d'encouragement, un cri du cœur qui leur inspirât la persévérance en les relevant à leurs propres yeux, et en ranimant leur espoir. Il aurait voulu aussi augmenter leur nombre et accroître leur

influence, en détournant des villes où ils végètent une partie des jeunes gens qui sortent de nos collèges ; il aurait voulu leur mettre une hache à la main, les conduire sur les frontières de nos paroisses, et leur dire : " Faites comme vos pères ; taillez-vous un domaine comme celui qu'ils se sont créé et sur lequel vous avez vécu. C'est ici que vous servirez le mieux votre pays et vos intérêts, que vous acquerrez le plus d'indépendance et de bonheur." Voilà toute la pensée de *Jean Rivard*, le défricheur et l'économiste. Il était difficile de trouver un plus beau sujet, et plus utile, plus capable de tenter un esprit élevé et une âme généreuse. Aucun de nos écrivains n'était mieux doué et mieux préparé que Gérin-Lajoie pour le traiter.

Un pareil travail exigeait une variété de connaissances peu commune, la maturité du talent et l'expérience pratique. Lajoie les avait acquises, et il les a mises admirablement à profit dans cette étude du colon canadien où il le suit pas à pas depuis son premier coup de hache dans la forêt, à travers toutes les phases de sa vie de défricheur, jusque dans sa carrière d'économiste, alors que, devenu riche et heureux, chef d'une charmante famille, placé à la tête de ses concitoyens dont il se montre le meilleur conseiller, il est élu député au parlement, et qu'il prend une part active aux affaires de son pays.

Un des grand mérites de l'auteur de *Jean Rivard* est d'avoir su rendre son livre intéressant sans sortir de la réalité, sans avoir eu recours à aucune de ces situations qui ne se rencontrent pas dans notre vie sociale et qui ne servent qu'à amuser l'imagination.

Jean Rivard est un héros que l'on peut coudoyer dans la rue, qui existe sous plus d'un nom dans nos campagnes et que bien des lecteurs ont désigné après avoir lu le beau livre de Gérin-Lajoie. Devenu populaire aujourd'hui, *Jean Rivard* a recueilli, dès son apparition, les suffrages des meilleurs juges, dont le nombre n'a fait que s'accroître.

Le plan du livre est bien conçu, le style sobre, naturel et correct. On a pu lui reprocher une certaine prolixité, quelques détails trop peu importants dans la vie du défricheur ; mais ces légères taches ont disparu dans une nouvelle édition où l'auteur a tout refondu l'ouvrage et lui a donné sa forme définitive. Avec une habileté rare, il a su le mettre tout à la fois à la portée de l'intelligence humble, et à la hauteur de l'esprit cultivé ; l'un et l'autre y trouvent l'*utile dulci* d'Horace, un sujet d'agrément et de réflexion. N'est-ce pas le plus grand éloge qu'on puisse faire d'un livre et d'un auteur ? Sans y penser, Gérin-Lajoie s'est peint lui-même dans *Jean Rivard*, avec son âme exquise, son patriotisme, son honnêteté, sa droiture, son désintéressement, en un mot tel que ses *Mémoires* nous le révèlent le meilleur des hommes. *Jean Rivard* est le premier livre canadien qui ait obtenu les honneurs de la reproduction en France. Un bon nombre des lecteurs du *Monde* de Paris où il a paru en feuilleton, ne soupçonnaient pas avant de l'avoir lu qu'il pût exister une littérature française de ce côté-ci de l'Atlantique.

Gérin-Lajoie a reçu de son vivant la plus douce récompense qu'il pouvait ambitionner : il a vu son livre donné en prix dans nos collèges, dans la plupart de nos écoles primaires, et répandu jusque dans la chaumière du colon, où sa lecture a déjà fait une partie du bien qu'il souhaitait, où elle continue à délasser les esprits et à ranimer les courages.

Si aujourd'hui le bon Gérin-Lajoie voyageait à travers nos paroisses nouvelles, il éprouverait, en plus d'un endroit, quelques-unes de ces suaves et intimes jouissances dont il parle dans ses *Mémoires*, lorsque, passant un soir dans une rue déserte de Trois-Rivières, il entendit une jeune mère de famille, assise dans l'embrasure d'une fenêtre ouverte, fredonner le *Canadien errant* en endormant son enfant. Il entendrait encore les couplets de

sa mélancolique chanson s'envoler de quelque mansarde ; et pour compléter son bonheur, il verrait, sous le même toit, plus d'une figure épanouie attentive à la lecture de *Jean Rivard.*

Cependant, quelles que soient les qualités que l'auteur a déployées dans cet ouvrage, il faut bien avouer qu'il n'y a mis qu'une part de lui-même, qu'il n'a guère révélé que le côté pratique, utilitaire de son talent. Ceci nous conduit à une observation plus générale.

Au point de vue purement littéraire, Gérin-Lajoie a-t-il tenu les promesses de son jeune âge ? A cette question nous devons répondre : certainement non.

Aucun de nos écrivains n'a montré un talent plus précoce, n'a donné tout d'abord de si belles espérances ; aucun n'est arrivé plus vite à la notoriété. Il était encore sur les bancs du collège, lorsque les feuilles publiques, avec un enthousiasme qui nous fait sourire aujourd'hui, mais qui s'explique, l'acclamèrent comme notre futur Racine.

Cependant, dès le début de sa carrière, on le vit s'arrêter soudainement, hésiter, puis s'engager dans une voie tout autre que celle qu'il avait rêvée et qu'on lui croyait destinée. Il n'est peut-être pas un seul de nos écrivains auquel s'applique d'une manière plus frappante cette réflexion de Crémazie : — " Que de jeunes talents parmi nous ont produit des fleurs qui promettaient des fruits magnifiques ; mais il en a été pour eux comme, dans certaines années, pour les fruits de la terre. La gelée est venue qui a refroidi pour toujours le feu de leur intelligence. Ce vent d'hiver qui glace les esprits étincelants, c'est le *res angusta domi* dont parle Horace, c'est le pain quotidien."

Quand, à force de travail ingrat, Gérin-Lajoie eut acquis ce pain du jour, le poète en lui était mort, la muse qui l'avait inspiré s'était envolée pour toujours.

Un autre homme cependant était né en lui. Au lieu du poète, nous avons eu le prosateur élégant et facile, l'économiste excellent. L'art a été immolé à l'utile. Lequel des deux eût été préférable ? A vingt ans, nous aurions incliné vers l'art, mais aujourd'hui ?...

Gérin-Lajoie a laissé en manuscrit une *Histoire de l'établissement du gouvernement responsable au Canada*, qu'il a écrite à la demande de plusieurs membres du parlement. Nous sommes en état d'en parler et de l'apprécier, quoique nous ne l'ayons pas actuellement en main, car nous avons eu le privilége d'en entendre la lecture de la bouche de l'auteur lui-même, il y a quelques années. Les motifs qui l'ont empêché de livrer cette *Histoire* au public peignent bien la bonté de caractère et la délicatesse des sentiments de Gérin-Lajoie. Il était occupé à y mettre la dernière main, lorsqu'il reçut une lettre de L. P. Turcotte, l'auteur du *Canada sous l'Union*, qui le priait de retarder la publication de ce manuscrit pour ne pas nuire à la vente de son livre qui venait de paraître.

Lajoie remit son manuscrit dans sa serviette, et ne l'en sortit plus. C'est une perte pour l'histoire de notre pays, car l'ouvrage est resté inachevé. Il y manque cependant peu de chose, et s'il était complété par une plume exercée, je suppose par M. Gérin, frère de Lajoie, ce serait un excellent récit de l'établissement du gouvernement responsable au Canada, et une réponse triomphante à l'injuste *Histoire des quarante dernières années*, de J. C. Dent.

Dans une étude humoristique, écrite il y a quelques années, j'ai essayé de résumer les transformations qu'avait subies le caractère de Gérin-Lajoie, dans la seconde période de sa vie.

" Il y a deux parts dans la vie de Gérin-Lajoie. L'homme d'aujourd'hui n'est pas l'homme d'autrefois.

" Autrefois, c'était le poète, avec ses rêveries, avec ses chansons, avec ses enthousiasmes ; c'était le journaliste qui écrivait l'article militant, chargé à mitraille, qui haranguait les électeurs sur la place publique.

" Aujourd'hui, c'est l'homme de cabinet, calme, silencieux, méditatif, un livre de philosophie ou d'économie politique à la main, cherchant quelque nouveau moyen d'amener le progrès et le bonheur parmi les hommes ; ou, mieux encore, c'est le père de famille, heureux au foyer domestique, entouré de sa femme et de ses enfants, ayant toujours sur les lèvres une bonne et utile leçon, un conseil sage, un service à proposer pour faire plaisir à un ami, tout cela arrosé du vieux vin de la gaieté française.

" L'utile a, peu à peu, envahi le domaine de la poésie.

" Cependant Gérin-Lajoie cultive encore, dans un coin de sa pensée, quelques fleurs d'illusion ; il bâtit des châteaux en Espagne. Il a surtout un rêve qu'il caresse, qu'il choye, qu'il espère réaliser tôt ou tard.

" Il voit, tout là-bas, dans une campagne retirée, paisible, ni trop loin ni trop près du village, une jolie ferme bien cultivée. Sur la ferme, une maison proprette, ni trop grande ni trop petite, avec des arbres alentour, un jardin et un verger.

" Un petit vieillard, à cheveux grisonnants, parcourt ce domaine, s'occupe d'améliorations, consulte ses voisins, leur parle de la récolte, d'un nouveau système plus économique de drainage ou d'assolement.

" Lorsqu'il traverse la cour, les pigeons descendent du colombier, et viennent s'abattre autour de lui ; un essaim de poules accourent manger, en caquetant, une poignée de grain qu'il leur jette, tandis que le coq, fièrement perché sur la clôture, chante à tue-tête son *Canadien errant.*

" Un beau soleil chaud de juillet ou d'août réjouit cette scène champêtre, douce comme une idylle.

" La laitière passe parmi les vaches, et s'en retourne à la maison portant deux chaudières pleines de lait jusqu'au bord et couvertes de deux doigts d'écume que les enfants enlèvent avec leurs mains.

" Le petit vieillard caresse, en passant, sa génisse de race ayrshire, qui se frotte tranquillement le dos le long de la barrière ; il interroge les moissonneurs qui arrivent devant la grange avec une charrette ployant sous les gerbes de blé, dont il écrase entre ses mains quelques épis pour s'assurer qu'ils sont beaux et bons.

" Enfin, content de sa journée, il va s'asseoir sur sa galerie, et regarde, en souriant, le soleil se coucher tout rouge derrière le coteau.

" Est-il nécessaire de dire que ce petit vieillard, c'est Gérin-Lajoie en personne ?

" Excellent homme ! Si tout le monde était bon et parfait comme lui, on verrait reparaître l'Eden sur la terre."

La fin de l'année 1865 inspirait à Gérin-Lajoie, sur la mort de quelques-uns de nos hommes publics, des regrets que le pays partageait avec lui. Il parle d'abord des ennuis que lui avait causés le changement de siège du gouvernement.

" L'année 1865 qui vient de finir a été remarquable pour moi à plus d'un titre. Le trait le plus saillant a été mon émigration de Québec à Ottawa, laquelle, avec le déménagement de la bibliothèque du parlement, a presque absorbé tout mon temps durant les trois derniers mois de l'année. Les soins de ce déménagement et les démarches que j'ai faites pour notre installation à Ottawa, toutes choses incompatibles avec mes goûts et mes

aptitudes, tout cela m'a fait vieillir de plusieurs années. Je crois réellement que c'est ce qui fait en grande partie que mes cheveux commencent à grisonner.

" Il faut dire aussi que j'ai eu durant l'année plusieurs peines de cœur qu'il me sera difficile d'oublier d'ici à longtemps. J'ai perdu plusieurs des hommes qui m'avaient fait le plus de bien et auxquels j'étais le plus attaché, entre autres, l'abbé Ferland (dont j'ai écrit la biographie pour le *Foyer canadien*), l'honorable A. N. Morin et sir Etienne P. Taché, deux hommes dont j'avais été le secrétaire intime pendant quelque temps, et qui m'avaient toujours montré un intérêt tout particulier.

" Peut-être le temps n'est-il pas éloigné où j'irai rejoindre ces anciens amis."

Gérin-Lajoie a toujours été sous l'impression qu'il ne vivrait pas jusque dans un âge avancé. Sans pouvoir s'en rendre compte, il s'attendait à être frappé un jour ou l'autre de paralysie. Atteint une première fois, environ deux ans avant sa mort, il y a succombé le 4 août 1882, jour anniversaire de sa naissance.

Lors de la création de la Société Royale, qui eut lieu peu de mois avant sa mort, on prétexta l'état de sa santé pour omettre son nom de la liste des membres qui fut soumise au marquis de Lorne.

Gérin-Lajoie fut très sensible à cette injustice, non qu'il tînt pour lui-même à cet honneur auquel, du reste, aucun de nos écrivains n'avait plus de titre que lui ; mais pour sa famille qui y aurait vu un juste hommage offert à ses talents et aux services qu'il avait rendus aux lettres canadiennes.

Cette ingratitude n'a eu pour effet que de relever davantage Gérin-Lajoie dans l'estime publique. Son mérite était au-dessus de pareilles distinctions, et il aurait fait honneur à la nouvelle société plus qu'à lui-même en y entrant.

La vie de Gérin-Lajoie se résume tout entière dans la devise qu'il s'était choisie : *Plus d'honneur que d'honneurs.* Cette existence sans tache a été un enseignement autant que ses écrits, et son nom sera toujours associé à ceux des hommes qui parmi nous ont bien mérité de la patrie.

VII — *La race française en Amérique,*

Par NAPOLÉON LEGENDRE

(Lu le 27 mai 1885)

Un grand nombre d'hommes sérieux ont affirmé à plusieurs reprises et à des époques différentes de notre histoire, que les Canadiens-français ont une mission providentielle à remplir sur ce continent. Cette assertion, reçue avec respect par les uns, a été, par d'autres, qualifiée de ridicule et de chimérique. Qui a raison, de ceux qui affirment ou de ceux qui se moquent ? Voilà la question posée clairement. Nous allons tâcher d'y répondre d'une manière aussi claire, non pas par une longue dissertation, mais par de simple faits. Car nous sommes à une époque où il semble que les faits seuls aient quelque valeur comme moyen de conviction.

Pour cela, nous parcourrons rapidement notre propre histoire — qui du reste n'est pas longue, car nous ne datons pas de bien loin — et, quand nous en aurons groupé les principaux traits, je crois que les conclusions se déduiront d'elles-mêmes.

Sans parler ici des voyages qu'ont pu faire, à une époque assez reculée, des pêcheurs français sur les bancs ou sur les côtes de Terre-Neuve, ni de l'expédition du baron de Léry de Saint-Just, en 1518 ; je commencerai au premier essai de colonisation que la France ait tenté dans ce pays, sous François Ier, par Jacques Cartier et de Roberval, de 1534 à 1544. On sait quelles difficultés les Français ont eu à subir à cette époque. Rigueur du climat, contre laquelle ils n'étaient pas prémunis ; attitude équivoque des sauvages, qui voyaient d'un œil jaloux — et avec raison — des étrangers s'emparer d'un sol qu'ils avaient droit de considérer comme leur patrimoine ; guerres et difficultés politiques sur l'ancien continent ; tout semblait conspirer pour faire naître le découragement parmi les hardis pionniers de la domination française dans ce pays. Et cela est tellement vrai que, de 1544 à 1578, le Canada ne fut plus visité que par des navires qui venaient y faire la pêche ou le commerce des fourrures.

Citons rapidement, après cette date, les expéditions de de La Roche et de Chauvin, qui n'eurent pas de grands résultats, pour arriver au commandeur de Chates, à M. de Pontgravé, à M. de Monts, et surtout à Champlain, cette grande figure placée à l'entrée de notre histoire comme un phare lumineux pour éclairer le véritable berceau de notre nationalité.

Port-Royal avait été fondé en Acadie, en 1605 ; mais c'est bien à la fondation de Québec, en 1608, que commence véritablement l'histoire de notre pays.

Pendant la période que nous venons de parcourir, Henri III, qui avait succédé à François Ier en 1574, avait été lui-même remplacé sur le trône, en 1593, par Henri IV, qui régna jusqu'en 1610.

Les commencements de Québec furent pénibles, non seulement à cause de la tempé-

rature des hivers, mais encore par suite de l'hostilité des Iroquois, auxquels Champlain avait, peut-être imprudemment, fait la guerre pour rendre service à ses alliés, les Algonquins et les Hurons.

Quoi qu'il en soit, si en 1615 la future capitale de la Nouvelle-France n'était pas encore bien considérable, une petite chapelle y était déjà construite près de l'endroit où se trouve aujourd'hui l'église de Notre-Dame-des-Victoires, et le 26 juin le père Dolbeau, un des quatre récollets arrivés de France un mois auparavant, y célébrait la première messe au son de l'artillerie.

On était alors sous le règne de Louis XIII, qui avait succédé à Henri IV, en 1610.

Ce ne fut qu'en 1625 que les révérends pères jésuites arrivèrent à Québec, bien qu'ils eussent déjà fondé une mission en Acadie, en 1611.

Quelques années plus tard, en 1629, la ville de Québec, dénuée de secours, tomba au pouvoir des frères Kerckt, qui s'y maintinrent jusqu'en 1632, où le traité de Saint-Germain-en-Laye la rendit à la couronne de France.

En 1634, M. de LaViolette fonda Trois-Rivières.

Deux événements importants signalent l'année 1635 : la fondation du collège des jésuites à Québec, et la mort de Champlain, qui jeta un deuil profond dans toute la colonie.

En 1639 arrivent les hospitalières et les ursulines ; les premières prennent possession de l'Hôtel-Dieu, qui avait été construit en 1636, et les secondes établissent leur couvent en 1641.

En 1642, M. de Maisonneuve fonda la ville de Montréal, qui devait être plus tard la métropole commerciale du Canada. La colonie, à travers tous les obstacles, augmente toujours, lentement mais sûrement. Les sulpiciens, arrivés à Montréal en 1657, y construisent l'église de Notre-Dame-de-Bonsecours en 1658.

1659 voit l'arrivée, à Québec, de Mgr de Laval, la fondation du séminaire de Montréal et celle du couvent de la Congrégation.

En 1660, Dollard ou Daulac et ses seize compagnons tiennent pendant dix jours contre sept cents Iroquois dans un vieux fort, au pied des Chaudières, sur la rivière Ottawa. Ils se font tuer jusqu'au dernier, mais leur conduite héroïque sauve la colonie de Montréal.

A cette époque, le Canada est en proie à des troubles sérieux résultant des altercations constantes entre les diverses compagnies qui exploitent les fourrures, et des discussions qui se produisent entre Mgr de Laval, d'une part, et MM. d'Avaugour et de Mésy, de l'autre, au sujet de la traite de l'eau-de-vie que les sauvages appelaient plus rationnellement l'*eau de feu.*

En 1663, la colonie passe de l'administration de la compagnie des Cent-Associés, sous le gouvernement direct du roi Louis XIV, qui établit des tribunaux à Québec, à Trois-Rivières et à Montréal, et un conseil supérieur pour administrer la justice, réglementer le commerce et prononcer sur toutes les affaires de police. La Nouvelle-France devenait une province française, et Québec était constitué en ville.

L'année 1665 voit arriver le marquis de Tracy en qualité de vice-roi, M. de Salières avec la deuxième division du régiment de Carignan, dont il était le colonel, M. de Courcelles, gouverneur, M. de Talon, intendant ; aussi un grand nombre de familles et d'artisans avec des chevaux — les premiers qu'on ait vus au pays — et des troupeaux. Bref, les nouveaux arrivants formaient une colonie plus nombreuse et mieux pourvue que celle

que l'on venait renforcer. On voit par là que le Canada commençait à prendre de l'importance, et que, en dépit de tous les obstacles, il continuait à grandir. Sa population était tout à fait exemplaire. Car, loin d'agir comme lors des premières expéditions et d'essayer de transporter ici des repris de justice, on choisissait au contraire les colons avec le plus grand soin et on expulsait ceux dont la conduite pouvait, après quelques temps de séjour, mériter trop de reproches. Je tiens à bien constater ce fait pour répondre à certains écrivains peu bienveillants qui n'ont pas craint de dire que nous n'avons pas toujours raison d'être fiers de nos ancêtres. Cette calomnie se refute d'elle-même pour ceux qui connaissent notre histoire.

En 1666, on commençait à construire la cathédrale de Québec, et, en 1668, le petit séminaire.

En 1672, arrive M. de Frontenac, dont la fermeté de caractère et la haute valeur ont tant fait pour la colonie. C'est sous son administration qu'ont eu lieu les grandes et fécondes expéditions de Jolliet et de Marquette jusqu'à l'embouchure de l'Arkansas, sur le Mississipi, et, plus tard, de Cavelier de la Salle et du chevalier de Tonti jusqu'au golfe du Mexique, à travers cette belle région qui reçut le nom de Louisiane.

La population française du Canada, vers cette époque (1683), avait atteint le chiffre de 10,251 âmes, réparties en plusieurs paroisses et missions, sans compter 600 Français établis en Acadie, et 25 soldats en garnison à Québec.

L'année 1686 est remarquable par les glorieux faits d'armes, à la Baie d'Hudson, des frères d'Iberville, qui devaient continuer à s'illustrer dans les mêmes régions jusqu'en 1694.

En 1689, Frontenac porte la guerre dans la Nouvelle-Angleterre et y soutient l'honneur des armes françaises. En 1690, il défend héroïquement Québec contre une flotte anglaise de trente-cinq voiles, commandée par William Phips, qui s'était déjà emparé de Port-Royal et de presque tous les postes de l'Acadie. Le bombardement dure quatre jours. Phips perd six cents hommes et dix vaisseaux. Il est forcé de lever le siège, et presque tous les vaisseaux qui lui restaient se perdent en descendant le fleuve.

En 1692 a lieu la mémorable défense du fort de Verchères par Mlle Magdeleine de Verchères. Je voudrais pouvoir citer en entier ici le récit naïf de ce prodigieux exploit, écrit de la main même d'une héroïne de quinze ans ; mais je suis obligé de passer rapidement sur les événements qui se groupent et se multiplient de plus en plus.

En 1697, la paix de Reyswick, signée à la fin de l'année, vient arrêter le projet que Frontenac avait formé de s'emparer de la Nouvelle-Angleterre.

En 1700, La Motte de Cadillac, dans le but d'étendre la domination française, commence un établissement au Détroit, avec cent Canadiens et un missionnaire. Malheureusement, la guerre qui se rallume entre la France et l'Angleterre, en 1703, et qui ramène les hostilités de ce côté-ci de l'océan, entrave les progrès qui s'étaient accentués pendant les années précédentes. La colonie souffre beaucoup, surtout de la prise du navire *La Seine*, par les Anglais. Ce navire portait une riche cargaison à destination de Québec, et amenait en ce pays le successeur de Mgr de Laval, l'évêque de Saint-Vallier, qui fut conduit en Angleterre et retenu prisonnier durant cinq ans.

En 1710, Port-Royal est pris par les Anglais, et perd son nom pour prendre celui d'Annapolis.

L'année suivante, au mois d'août, l'amiral Walker remonte le fleuve avec une flotte

puissante, pour assiéger Québec ; mais presque tous ses vaisseaux périssent à la baie des Sept-Iles.

En 1712, les hostilités cessent, et en 1713, le traité d'Utrecht cède à l'Angleterre l'Acadie, Terre-Neuve, la Baie d'Hudson, et tout le pays des Iroquois, au sud du fleuve et des grands lacs. On voit que le grand Louis XIV, comme Louis XV en 1763, n'hésita pas à nous abandonner, ce qui ne nous a point empêchés de conserver pour notre mère patrie la même affection profonde et sincère. Du reste, la Providence, qui est au-dessus des rois et des diplomates, ne devait jamais nous retirer sa protection.

C'est après ce traité que les Français, pour se ménager l'entrée du golfe, fondent Louisbourg, dans l'île du Cap-Breton, en 1715. Cette même année arrive la mort de Louis XIV, et la France reste sous la régence du duc d'Orléans jusqu'en 1743.

En 1723, on construit à Québec deux navires de guerre et six bâtiments marchands. C'est le commencement de cette grande industrie qui devait plus tard, et pendant si longtemps, faire la richesse de la cité de Champlain. A cette époque, Québec comptait 7,000 habitants, et Montréal 3,000. Quelques vingt ans plus tard, en 1744, la population française du Canada avait atteint le chiffre de 50,000 âmes.

En 1746, Louisbourg tombe au pouvoir des Anglais, mais elle est rendue à la France deux ans après par le traité d'Aix-la-Chapelle.

A partir de 1752, les hostilités se rallumèrent entre le Canada et les colonies anglaises au sujet d'un territoire que ces dernières réclamaient dans la vallée de l'Ohio ; ces hostilités eurent leur épisode tragique dans la conquête de l'Acadie par Monkton, et la déportation des malheureux Acadiens sur une terre étrangère en 1755. Mais c'est l'année 1756 surtout qui doit être pour nous une date néfaste ; c'est à cette époque, en effet, qu'éclata cette fameuse guerre de sept ans, qui devait se terminer d'une façon si douleureuse pour notre nationalité.

Je ne veux pas, quelque intérêt que ce récit puisse avoir, retracer tous les événements de cette campagne, qui ne se termine qu'en 1760 par la capitulation de Montréal. Qu'il me suffise de signaler les principaux faits qui doivent rester présents à notre mémoire. En 1758, le 8 juillet, a lieu la célèbre bataille de Carillon, où Montcalm, avec 3,600 soldats, force le général Abercrombie, après six heures de lutte, à retraiter avec 16,000 hommes de ligne. Le 13 septembre 1759, se livre la grande bataille des Plaines, où Montcalm et Wolfe perdent tous deux la vie. Le 16 du même mois, Québec, commandé par M. de Ramezay, capitule. Puis, malgré les héroïques efforts de Lévis, dans le même automne et au printemps suivant, malgré la victoire de Sainte-Foye, le 27 avril 1660, — les armes anglaises finissent par triompher, grâce à l'état d'abandon dans lequel la colonie se trouve, et M. de Vaudreuil se voit obligé, le 8 septembre, de rendre la ville de Montréal au général Amherst. Enfin, le 10 février 1763, par le traité de Paris, le roi Louis XV cède à l'Angleterre ce beau pays que nos ancêtres avaient arosé de leurs sueurs et de leur sang ; le drapeau français repasse tristement la mer, et celui de la Grande-Bretagne déroule ses plis triomphants à nos yeux voilés de pleurs.

Une grande partie des colons français, les chefs surtout, abandonnent le Canada et rentrent en France. Mais le peuple, c'est-à-dire la véritable force de la colonie, ne veut pas quitter le sol auquel il est attaché ; il subira un joug étranger, mais il restera fièrement sur ce continent pour y conserver et y perpétuer sa race et ses traditions.

Ceux qui restèrent ainsi dans le pays étaient au nombre de 65,000 environ. Pour

eux commence dès lors une existence de luttes continuelles contre un vainqueur dont tous les efforts tendaient constamment, on le conçoit, à l'unification de la colonie, et par conséquent à l'effacement de la race française. Pensons à ce que font aujourd'hui les Prussiens pour germaniser l'Alsace-Loraine, aux mille persécutions cruelles et honteuses qu'ils font subir à ce pauvre peuple, dont le seul tort est de vouloir rester français, et nous nous formerons facilement une idée de ce qu'ont dû souffrir nos pères, placés dans une situation analogue à une époque où l'on était encore moins scrupuleux sur les moyens à employer pour parvenir au but.

Après la capitulation de Montréal, le Canada passe sous un gouvernement militaire, puis sous une administration mi-partie civile et militaire, à laquelle les Canadiens-français ne pouvaient point prendre part à cause du serment du test [1] qu'on les obligeait de prêter.

Cette administration avait pour chef le général Murray, qui, personnellement, était assez favorablement disposé à l'égard des Canadiens-français ; mais il était obligé d'obéir aux instructions précises qu'il avait reçues du gouvernement anglais.

Sous Carleton, son successeur, de 1766 à 1774, les Canadiens furent un peu moins maltraités, par suite de la crainte qu'on avait d'un soulèvement dans les autres possessions anglaises de l'Amérique du Nord. En 1774, l'acte de Québec étendit davantage nos libertés politiques, sans toutefois nous accorder toute la justice à laquelle nous avions droit.

L'année suivante, les colonies anglaises se soulevèrent contre l'Angleterre, mais les Canadiens-français, malgré les plus pressantes sollicitations, refusèrent de prendre part au mouvement, et restèrent fidèles à la couronne d'Angleterre ; ce fut alors que les insurgés tentèrent de s'emparer du Canada par la force des armes. Cette campagne fut d'abord marquée de succès sous la conduite de Montgomery, qui prit plusieurs forts, fit occuper Sorel et Trois-Rivières, et força Carleton à abandonner Montréal pour venir se réfugier à Québec. Dans cette dernière ville, les opinions étaient divisées parmi la population anglaise, et si les Canadiens avaient alors voulu faire cause commune avec les insurgés, c'en était fait de la domination de l'Angleterre dans toute l'Amérique du Nord. Ce fut, dans cette occasion, leur fidélité et leur bravoure qui conservèrent le Canada à la couronne britannique. Il est bon d'appuyer de temps à autre sur ce fait, que bien des gens sont trop portés à oublier ou à dénaturer.

Dans le mois de décembre de la même année, Montgomery paraissait devant Québec avec une armée de siège composée de ses propres troupes et de celles d'Arnold, qui était venu le rejoindre par la vallée du Kennébec et de la Chaudière. On se rappelle comment, dans la nuit du 30 au 31 décembre, Montgomery trouva la mort au pied de nos murailles, et comment le général Arnold, qui lui succéda, reprit le siège au printemps suivant, mais fut obligé de se retirer précipitamment à la nouvelle de l'approche de quelques navires de guerre.

Cette même année 1776, les hostilités se poursuivirent en d'autres endroits de la colonie. Mais le général Burgoyne réussit à repousser l'ennemi presque sur tous les

[1] Par ce serment, que tous les fonctionnaires étaient tenus de prêter, on abjurait la doctrine de la transubstantiation, du sacrifice de la messe et de l'invocation de la sainte Vierge et des saints. On en dispensa les catholiques plus tard, par l'acte de 1774, et il fut formellement aboli en 1828.

points. L'année suivante cependant, ayant voulu envahir l'Etat de New York, il y fut cerné par les troupes américaines et fut obligé de déposer les armes.

L'année 1778 est remarquable par l'arrivée du gouverneur Haldimand, un des plus cruels despotes qui nous soient venus d'outre-mer. Aux Etats-Unis la lutte se continue avec l'appui des soldats de la France, sous la conduite de Lafayette et de Rochambeau, pour se terminer enfin au traité du 3 septembre 1783, par lequel l'Angleterre reconnaît l'indépendance de la nouvelle république. Ici, les Canadiens continuent à gémir sous la main de fer de Haldimand, et, malgré cela, la province de Québec supporte vaillamment son sort, puisqu'elle compte, en 1784, environ 113,000 habitants dont plus des trois-quarts sont canadiens-français.

En 1791, grâce à nos pressantes sollicitations, l'Angleterre abolit le gouvernement civil absolu qui nous avait régis depuis 1774, pour nous donner une constitution un peu plus libérale. Parmi les colons anglais du pays, cette constitution fut reçue avec un dépit extrême, parce qu'elle nous permettait de prendre notre part de place au soleil. Aussi, son inauguration fut-elle le point de départ de luttes sans nombre dans lesquelles nos députés canadiens déployèrent la plus grande vigueur et le plus grand talent pour maintenir nos droits. Pour apprécier justement ces faits, il faut tenir compte des longues et sanglantes guerres qui avaient eu lieu entre la France et l'Angleterre, et qui avaient provoqué entre les deux nations une haine invétérée dont le contre-coup se faisait sentir ici. Il y a loin de ces sentiments violents aux marques d'estime que se sont donnés les deux mêmes peuples sous les murs de Sébastopol, et aux bons rapports d'amitié qui unissent maintenant les deux races sur cette terre du Canada, qui fut le théâtre de leurs anciennes et ardentes contestations.

En 1806 parut le *Canadien*, le premier journal français publié dans cette province.

En 1807, sous l'administration despotique de sir James Craig, les luttes en parlement recommencent, et le gouverneur, usant ou plutôt abusant du droit du plus fort, fait emprisonner un certain nombre de Canadiens distingués qui soutenaient hardiment la cause de leurs compatriotes. Cependant, en 1811, le départ de Craig et l'arrivée de sir George Prevost ramènent une paix relative dans la colonie.

En 1812, la guerre se déclare entre l'Angleterre et les Etats-Unis, et notre pays devient naturellement le théâtre de la lutte. Le souvenir de cette campagne est encore tout vivant dans notre mémoire, grâce à la part glorieuse qu'y prirent les nôtres, et surtout à l'immortelle bataille de Châteauguay, dans l'automne de 1813, bataille qui n'a peut-être de comparable, dans les annales militaires, que le célèbre fait d'armes de Léonidas et de ses trois cents Spartiates. Cette fois encore, le règne de l'autorité anglaise dans ce pays est sauvé en grande partie par le courage et la loyauté de nos compatriotes.

En 1818, la lutte recommence entre les chambres et le duc de Richmond, un despote qui rappelait les temps horribles de l'administration de Haldimand. C'est au cours de ces luttes que se distinguèrent Louis-Joseph Papineau, alors âgé de vingt-huit ans à peine, et MM. Cuvillier, Neilson et autres députés, qui défendaient noblement et courageusement nos droits attaqués.

En 1822, on tente de faire voter, dans le parlement impérial, un bill d'union en faveur du Haut-Canada. Ce bill proscrivait la langue française, restreignait les libertés du culte et enlevait aux représentants du peuple le droit de disposer des deniers publics. Heureusement, et grâce à l'esprit libéral de la majorité dans les chambres anglaises, ce bill

fut rejeté à sa seconde lecture; mais l'impulsion, une fois donnée, devait se faire ressentir plus tard.

Peu après, l'hostilité entre la chambre et le gouverneur (le comte de Dalhousie), se réveilla pour ne cesser qu'en 1828, à l'arrivée de sir James Kempt qui, plus politique et surtout plus juste que son prédécesseur, réussit à ramener une tranquillité apparente. Depuis cette époque, cependant, les esprits, aigris par tant de vexations et d'injustices, supportaient difficilement de nouveaux empiètements. Le pays se sent mal à l'aise et s'agite, on fait des assemblées, on discute la situation, et, en 1834, les fameuses 92 *Résolutions* viennent donner un corps aux grief de la colonie contre la métropole. Le gouvernement impérial nomme alors une commission royale pour s'enquérir de l'état des choses. Naturellement le rapport de cette commission tout à fait hostile aux Canadiens-français, fut, malgré cela, peut-être même à cause de cela, adopté par le gouvernement et les chambres d'Angleterre. Le Haut-Canada, qui avait d'abord pris part à l'agitation, se déclara satisfait, de même que le Nouveau-Brunswick et la Nouvelle-Ecosse, en sorte que le Bas-Canada se trouva tout à fait isolé. Cependant les nôtres ne reculèrent pas, et la majorité de l'assemblée législative protesta solennellement contre le rapport partial de la commission royale. Mais lord Gosford, qui croyait avoir facilement raison de ce mouvement, se hâta de proroger les chambres, après six jours de session seulement, et destitua M. Papineau ainsi que plusieurs officiers de milice auxquels le peuple fit un véritable triomphe. La coupe était pleine, et les troubles éclatèrent à Montréal le 7 novembre 1837. On sait quel a été le résultat, facile à prévoir du reste, de cette rébellion où une poignée d'hommes sans armes tinrent tête, victorieusement plusieurs fois, à des troupes bien disciplinées et vingt fois supérieures en nombre. Enfin, écrasés par la masse de leurs adversaires, les nôtres durent céder. Plusieurs d'entre eux payèrent leur conduite patriotique par la mort sur l'échafaud; d'autres durent prendre le chemin de l'exil, pendant que sir John Colborne, à la tête de 8,000 hommes, remportait un succès facile et peu glorieux contre des femmes, des enfants et des vieillards, et semait partout le pillage et l'incendie. Et qu'on n'aille pas croire que, dans cette occasion, nous ayons été les seuls à nous redresser sous un joug devenu trop pesant; un grand nombre de colons d'une autre origine faisaient cause commune avec nous; quelques-uns se sont affirmés hardiment et ont même combattu à nos côtés. Cela ne prouve-t-il pas qu'après tout notre conduite était beaucoup plus excusable qu'on ne l'a représentée? Du reste, c'est bien ainsi que le comprit lord Durham, successeur de lord Gosford, puisque, peu de temps après son arrivée, il accordait une amnistie entière aux prisonniers politiques arrêtés pendant les troubles. Cet acte de justice fut cependant désavoué en Angleterre, et lord Durham en fut si fortement affecté qu'il donna sa démission et retourna de suite dans son pays. Mais il est dangereux d'appuyer sur ce terrain encore brûlant et d'apprécier des faits trop rapprochés de nous. Contentons-nous de donner en passant un pieux souvenir à ceux qui ont combattu pour nos libertés, et de répandre une larme reconnaissante sur la tombe de ceux qui sont morts pour la grande et glorieuse cause de la patrie.

C'est après ces troubles que le parti anglais reprit l'idée, qu'il avait émise en 1822, de réunir sous un seul gouvernement le Haut et le Bas-Canada. Le bill qui établit cette union fut sanctionné en Angleterre en 1840, mais ne devint loi qu'en 1841. Il était peut-être moins injuste que celui de 1822; cependant il proscrivait l'usage de la langue française en parlement, et accordait au Haut-Canada, qui n'avait pas plus de la moitié de

la population du Bas-Canada, une représentation égale à celle de ce dernier. Le Bas-Canada comptait, à cette époque, 524,000 âmes ; c'est-à-dire que, depuis 1791, en cinquante ans, sa population s'était quintuplée.

L'honorable Chs Poulett Thompson, qui avait fortement travaillé à amener l'union de 1841, et qui revenait en ce pays sous le nom de lord Sydenham, fut chargé d'inaugurer la nouvelle constitution. Il se choisit un conseil exclusivement anglais, et laissa les nôtres complètement de côté. Ce début était gros de dangereuses promesses. Du reste l'administration de lord Sydenham ne fut pas de longue durée, car il mourut dans l'automne de la même année. Il fut remplacé par sir Charles Bagot qui, plus équitable que son prédécesseur, accorda à notre race la représentation à laquelle elle avait droit dans le conseil des ministres et dans les emplois publics, et choisit comme chef de son cabinet MM. Louis-Hippolyte Lafontaine et Robert Baldwin, deux hommes d'un talent reconnu et d'une grande largeur d'idées. Sir Charles Bagot ayant demandé son rappel, à cause du mauvais état de sa santé, fut remplacé par sir Charles Metcalfe, qui arriva à Kingston, où siégeait le parlement, le 25 mars 1843. L'administration Lafontaine-Baldwin continuait à jouir de la confiance de la députation ; mais le gouverneur, ayant jugé à propos de faire les nominations aux emplois sans consulter son cabinet, ce dernier trouva avec raison que ses privilèges étaient méconnus et donna sa démission. Le gouverneur essaya de former une nouvelle administration sans y réussir. Il fut obligé de nommer un conseil provisoire composé de MM. Draper, Viger et Day. Enfin, après une crise qui dura près d'un an, il parvint à former un cabinet composé de sept membres, et proclama la dissolution du parlement. Dans les élections générales qui eurent lieu, il réussit, grâce à une intervention personnelle, à obtenir dans la chambre une majorité de quelques voix conforme à ses idées. Le siège du gouvernement fut transporté à Montréal, et l'administration se traîna tant bien que mal, malgré quelques remaniements, jusqu'au départ de sir Chs Metcalfe, en 1845, puis, sous lord Cathcart, jusqu'à l'arrivée de lord Elgin, en 1847. On doit cependant rendre cette justice au cabinet Viger-Draper : ce fut sous son administration que l'amnistie fut accordée aux exilés de 1837, et qu'il fut voté une adresse demandant le rappel de la clause qui proscrivait la langue française. Cette clause ne fut toutefois rappelée qu'en 1848. A son arrivée, lord Elgin vit du premier coup d'œil que le ministère n'avait pas la confiance du pays, mais, dans le but d'éprouver constitutionnellement sa force, il lui accorda des élections générales qui furent, cette fois, conduites plus régulièrement et plus honorablement. L'effet prévu ne manqua pas de se produire. Au premier vote, le cabinet qui avait déjà reçu un sérieux échec par l'élection de M. Morin au poste d'orateur contre le candidat ministériel, sir Allan McNab, par une majorité de 54 voix, fut littéralement balayé, et lord Elgin rappela MM. Lafontaine et Baldwin, qui formèrent une administration puissante dans laquelle entrèrent MM. R. E. Caron, E. P. Taché et L. M. Viger.

En 1849, à l'ouverture des chambres, lord Elgin inaugura solennellement le rétablissement de la langue française dans le parlement en prononçant le discours du trône en français. C'est le premier gouverneur anglais qui nous ait fait cette courtoisie. Aussi, les Canadiens-français en éprouvèrent-ils un sentiment de profonde joie.

Ce fut pendant cette session que la chambre vota, malgré la plus violente opposition, un bill indemnisant les habitants du Bas-Canada qui avaient éprouvé des pertes par les troubles de 1837-38, comme la chose s'était déjà faite du reste pour le Haut-Canada. Tout avait été mis en œuvre pour empêcher l'adoption de cette mesure ; mais la rage de l'opposi-

tion ne connut plus de bornes lorsque lord Elgin vint donner au bill la sanction souveraine. Le gouverneur fut insulté et assailli par une populace en démence, et, dans la même nuit, les édifices du parlement furent incendiés, avec les deux riches bibliothèques qu'ils contenaient. La conduite du gouverneur fut cependant approuvée en Angleterre, et, malgré toutes les démarches qui furent faites pour obtenir son rappel, il conserva sa charge jusqu'en 1854. Découvrons nos fronts chaque fois que nous entendrons prononcer le nom de lord Elgin, qui fut l'ami si dévoué et si fidèle des Canadiens-français. Il eut l'âme assez haute pour s'affranchir des préjugés de race et remplir ses fonctions avec la plus stricte impartialité ; il n'a pas craint même d'exposer sa vie lorsqu'il s'est agi de nous rendre la justice à laquelle nous avions droit. Son souvenir doit rester gravé dans le cœur de tout Canadien-français qui aime véritablement son pays. C'est sous son administration que s'est fait réellement le plus fort de la lutte entre l'élément français et l'élément anglais, et que le premier a finalement triomphé. Nous avions, à cette époque, de redoutables ennemis, mais nous avions aussi de puissants défenseurs. Parmi ceux qui se sont prononcés le plus fortement contre les Canadiens-français, sir Allan McNab a peut-être été le plus violent, le plus acharné. Il nous qualifiait de rebelles et d'étrangers, et jetait à tous les vents ce cri qui était devenu la devise de nos adversaires : *No French domination !* " L'union, disait-il, a été faite dans le seul but de réduire les Canadiens-français sous la domination anglaise, et l'on obtiendrait l'effet tout contraire ! Ceux que l'on voulait écraser dominent ; ceux en faveur de qui l'union a été faite sont les esclaves des autres ! J'avertis le ministère que la marche qu'il suit est propre à jeter le Haut-Canada dans le désespoir et à lui faire sentir que, s'il doit être gouverné par des étrangers, il lui serait bien plus avantageux d'être gouverné par un peuple voisin, de même race, que par ceux avec qui il n'a rien de commun, ni par le sang, ni par la langue, ni par les intérêts."

Plusieurs autres députés parlèrent dans le même sens et avec autant de haine. Cependant, notre cause était défendue avec un talent et une ardeur également remarquables. A part les discours éloquents et patriotiques de MM. Lafontaine, Taché, Caron, Papineau, Cauchon, Cartier, Chauveau, Turcotte et Drummond, nous avions en notre faveur l'appui sincère et puissant à la fois de MM. Baldwin, Hincks, Price, Blake, Merritt, Nelson et autres Canadiens-anglais, qui surent se mettre au-dessus des préjugés soulevés par les différences de race, et traiter la question au seul point de vue de la justice et de l'équité.

Après la sanction du bill qui avait soulevé tant de tempêtes, l'agitation continua encore pendant quelque temps, entretenue par les articles violents des journaux hostiles au gouvernement. On fit des assemblées où les agitateurs se prononcèrent fortement en faveur de l'annexion. Mais la victoire était décidément passée dans notre camp, et l'insuccès constant de nos ennemis finit par les lasser. Ils cédèrent pour ne pas succomber sous le ridicule qui menaçait de les achever, et vinrent d'eux-mêmes, plus tard, faire alliance avec nous. Depuis cette époque jusqu'à la confédération, nous avons conservé notre place et notre influence dans les conseils de l'Etat, et, malgré quelques difficultés passagères, notre race à su faire respecter les droits qu'elle avait reconquis au prix de si longs et de si rudes combats.

En 1851, avait lieu à Québec le premier concile provincial sous la présidence de l'archevêque Turgeon ; et, l'année suivante, une charte royale établissait l'université Laval, qui fut inaugurée solennellement en 1854 par lord Elgin.

En 1855, la *Capricieuse*, corvette française commandée par M. de Belvèze, entrait dans le port de Québec. C'était le premier vaisseau de guerre français qui jetait l'ancre devant cette ville, depuis l'époque de la cession. Aussi le pavillon tricolore fut-il salué avec le plus grand enthousiasme, non seulement par la ville de Québec, mais par la population française et anglaise de tout le pays. Cet événement éveilla le chant de nos poètes, et l'on se rappelle encore les accents patriotiques avec lesquels MM. Octave Crémazie et Louis Fiset célébrèrent l'arrivée de nos frères d'outre-mer. Voici quelques-unes des strophes écrites par M. Crémazie à cette occasion ; je les cite pour montrer combien notre littérature s'était déjà développée :

LE VIEUX SOLDAT CANADIEN

Vous souvient-il des jours, vieillards de ma patrie,
Où nos pères, luttant contre la tyrannie,
Par leurs nobles efforts sauvaient notre avenir ?
Frémissant sous le joug d'une race étrangère,
Malgré l'oppression, leur âme, toujours fière,
De la France savait garder le souvenir !

Puis, il raconte la vie d'un vieux soldat qui, toujours rempli d'espérance et frémissant de joie à chaque bulletin qui annonce le triomphe des armes françaises, attend patiemment le retour du drapeau pour lequel il a combattu, et entonne ce chant patriotique que chacun devrait savoir par cœur :

— Pauvre soldat, aux jours de ma jeunesse,
Pour vous, Français, j'ai combattu longtemps ;
Je viens encor, dans ma triste vieillesse,
Attendre ici vos guerriers triomphants.
Ah ! bien longtemps les attendrai-je encore,
Sur ces remparts où je porte mes pas ?
De ce grand jour quand verrai-je l'aurore ?
Dis-moi, mon fils, ne reviendront-ils pas ?

Malheureusement le drapeau de la France a tardé trop longtemps, et le vieux soldat n'a pas pu l'attendre.

Ecoutons le poète :

Un jour, pourtant, que grondait la tempête,
Sur les remparts on ne le revit plus :
La mort, hélas ! vint courber cette tête
Qui tant de fois affronta les obus.
Mais, en mourant, il redisait encore
A son enfant qui pleurait dans ses bras :
— De ce grand jour tes yeux verront l'aurore ;
Ils reviendront, et je n'y serai pas !

Le poète continue :

Tu l'as dit, ô vieillard, la France est revenue ;
Au sommet de nos murs, voyez-vous dans la nue,

Le noble pavillon dérouler sa splendeur ?
Ah ! ce jour glorieux où les Français, nos frères,
Sont venus pour nous voir du pays de nos pères
Sera le plus aimé de nos jours de bonheur !

Citons encore ces deux strophes de l'*Envoi* aux marins de la *Capricieuse :*

Ah ! pendant les longs jours où la France oublieuse
Nous laissait à nous seuls la tâche glorieuse
De défendre son nom contre un nouveau destin,
Nous avons conservé le brillant héritage
Légué par nos aïeux, pur de tout alliage,
Sans jamais rien laisser aux ronces du chemin.

Enfants abandonnés, bien loin de notre mère
On nous a vus grandir à l'ombre tutélaire
D'un pouvoir trop longtemps jaloux de sa grandeur [1].
Unissant leurs drapeaux [2], ces deux reines suprêmes
Ont maintenant chacune une part de nous-mêmes :
Albion notre foi, la France notre cœur !

Ces vers sont bien loin d'être sans défauts, mais ils sont remplis de cœur, et le cœur sait admirablement remplacer bien des choses.

M. de Belvèze était venu avec la mission d'établir des relations commerciales entre la France et son ancienne colonie. Le résultat de cette mission fut en effet la nomination d'un consul de France à Québec et la modification du tarif français relativement à l'entrée des navires canadiens dans les ports de la France. Ce consulat ne fut néanmoins établi qu'en 1858 et M. le baron Gauldrée-Boileau en fut le premier titulaire.

C'est pendant le séjour de M. de Belvèze à Québec qu'eut lieu la pose solennelle de la pierre angulaire du monument commémoratif de la bataille de Sainte-Foye. Cette cérémonie se fit avec le plus grand éclat, en présence des deux représentants de la France et de l'Angleterre, M. de Belvèze et sir Edmund Head, alors gouverneur général. Les ossements des braves tombés sur le champ de bataille sont confondus dans une fosse commune, sans distinction d'origine, et avec eux repose — à jamais, espérons-le — la hache de guerre qui avait été levée si souvent entre les deux nationalités. La belle statue qui couronne ce monument a été offerte par la France, qui a voulu ainsi contribuer, pour sa bonne part, à cette œuvre de piété nationale. C'est à l'occasion de cette cérémonie que M. Chauveau prononça un discours qui a été depuis et sera toujours considéré comme une des pages les plus belles et les plus émues de l'éloquence française.

En 1857 a lieu la fondation de quatre écoles normales, qui forment le point de départ d'une ère de progrès considérable dans l'instruction publique de ce pays.

En 1864 s'ouvrent les premières négociations entre les différentes provinces de la colonie pour établir une confédération. La constitution de 1841 avait fait son temps ; les rapports entre le Haut et le Bas-Canada commençaient à être extrêmement tendus, et une crise menaçait d'éclater. Un projet de constitution longuement discuté, tant ici qu'en

[1] On a vu que ce pouvoir n'a pas toujours été aussi tutélaire que le dit le poète.
[2] Allusion à la guerre de Crimée.

Angleterre, fut enfin voté dans le parlement impérial et sanctionné par Sa Majesté, le 23 mai 1867. La Confédération se composait des provinces d'Ontario (anciennement Haut-Canada), de Québec (anciennement Bas-Canada), du Nouveau-Brunswick et de la Nouvelle-Ecosse. Elle fut inaugurée le 1er juillet de la même année. Plus tard, elle s'augmenta des provinces de Manitoba, du Nord-Ouest, de la Colombie Britannique, comprenant l'Ile Vancouver, et de l'Ile du Prince Edouard.

Ce n'est pas ici le moment de rechercher si l'acte fédératif a eu tous les résultats qu'on en attendait ; bornons-nous à constater qu'il a établi et sanctionné d'une manière définitive les droits de notre race. Nous possédons enfin ce châteaufort pour lequel nous avons toujours combattu : nos institutions, notre langue et nos lois. Nous avons notre code civil, nos lois d'instruction publique, notre système municipal, et, par-dessus tout, le libre exercice de notre culte religieux. Quant à notre langue, elle est une des langues officielles non seulement dans notre province de Québec, mais même dans le parlement fédéral. L'article 133 de la constitution s'exprime ainsi :

" Dans les chambres du parlement du Canada et dans les chambres de la législature de Québec, l'usage de la langue française ou de la langue anglaise, dans les débats, sera facultatif; mais dans la rédaction des archives, procès-verbaux et journaux respectifs des deux chambres, l'usage de ces deux langues sera obligatoire et dans toute plaidoirie ou pièce de procédure par devant les tribunaux ou émanant des tribunaux du Canada qui seront établis sous l'autorité du présent acte, et par devant tous les tribunaux de Québec, il pourra être fait également usage, à faculté, de l'une ou l'autre de ces langues. Les actes du parlement du Canada et de la législature de Québec devront être imprimés et publiés dans ces deux langues."

Ainsi cette belle langue qui est restée la langue officielle de presque toutes les cours d'Europe, et dont nous sommes les dépositaires et les gardiens sur ce continent, non seulement nous l'avons conservée dans toute sa pureté et son intégrité, mais nous l'avons même imposée à ceux qui voulaient la faire disparaître ; nous l'avons fait mettre sur un pied d'égalité avec la langue anglaise.

Pendant toutes ces longues luttes, loin de nous amoindrir, nous nous sommes développés de toutes les manières. Notre littérature s'est formée et a grandi rapidement. Aujourd'hui les ouvrages de nos écrivains sont lus en Europe, surtout en France, où ils vont nous faire connaître et resserrer les liens qui nous ont toujours tenus attachés à la mère patrie. Nos littérateurs échangent leurs ouvrages avec les littérateurs français, et il se produit entre eux des rapports de courtoisie et d'amitié même, dont nous ne pouvons que bénéficier. Un des nôtres a déjà été couronné pas l'Académie française, le plus haut tribunal du monde entier, et ici, dans la Société Royale canadienne, fondée par le marquis de Lorne, sur quatre-vingt sièges, nous en possédons vingt-six.

Et par quel travail, par quels efforts constants en sommes-nous arrivés à ce résultat ! Placés dans une position inférieure à tous les points de vue, nous étions obligés d'apprendre et de parler une langue étrangère pour faire valoir ou défendre nos droits devant les tribunaux, la législature ou l'exécutif ; il nous fallait encore savoir l'anglais pour ne pas être exposés constamment à des désagréments sérieux dans les rapports les plus ordinaires de l'existence sociale. Dans les campagnes cet inconvénient se faisait moins sentir ; mais, dans les villes et les centres un peu considérables, c'était un danger de tous les jours. Nous n'avions pas de livres, presque pas de journaux français,—et je parle ici d'une époque

qui n'est pas très éloignée ;—cependant malgré tous ces obstacles, ces périls, nous n'avons pas cédé, nous avons tenu tête au courant qui nous faisait glisser presque irrésistiblement sur la pente de l'anglicisation. Tout en étant loyaux sujets de l'Angleterre, nous sommes toujours restés, et nous sommes encore français par le langage, français par le cœur.

D'un autre côté, les persécutions ont été loin de nous faire diminuer en nombre. Au contraire nous nous sommes développés dans des proportions étonnantes, et les quelques milliers de familles qui sont restées sur ce vieux sol de France, à l'époque de la cession, sont devenues aujourd'hui une population de plus de treize cent mille âmes dans la province de Québec et le Dominion, sans compter sept cent mille des nôtres qui sont établis aux Etats-Unis et qui forment là autant de foyers vivants où se réchauffent et se perpétuent les traditions du pays et les caractères de notre nationalité. Et ce n'est pas seulement dans la province de Québec que nous nous emparons du sol ; dans toutes les autres parties du Dominion, nous prenons aussi de l'expansion. Dans les provinces inférieures, notre race envoie des représentants aux législatures et au parlement fédéral, elle compte même des ministres dans les cabinets provinciaux. Au Manitoba, les nôtres font encore davantage sentir leur influence ; et, même dans Ontario, la province la plus essentiellement britannique du Dominion, le palais législatif a entendu il y a deux ans pour la première fois et avec un frémissement de profonde stupéfaction, un discours en langue française. C'est un des nôtres qui a ainsi vaillamment affirmé le droit que lui confère son titre de député d'un des plus florissants comtés d'Ontario. Du reste, cette province envoie déjà depuis plusieurs années des députés français au parlement fédéral.

Aux Etats-Unis, nos compatriotes ne se contentent pas d'être les meilleurs ouvriers des fabriques ; ils se font une place marquante dans les professions et dans les charges publiques, et commencent à faire sentir une influence sérieuse dans le résultat des élections. Plusieurs d'entre eux ont été élus, cette année, aux législatures des différents Etats. Partout, même dans les territoires les plus éloignés de l'Union, vous rencontrerez une ville, un village, une rivière, un lac, une plaine ou une montagne qui porte un nom français. C'est un de nos hardis Canadiens qui a pénétré autrefois dans ces solitudes, sa hache à la main et sa carabine sur l'épaule ; il a fondé un établissement qui a grandi avec ses descendants, et son nom est resté attaché à l'endroit comme un monument impérissable de son courage et de sa puissante vitalité. De la vallée du Saint-Laurent et des grands lacs jusqu'au golfe du Mexique, de distance en distance, vous trouvez des groupes de Canadiens-français, comme autant de jalons qui relient la province de Québec et le territoire de l'Ouest avec la Louisiane. La même chaîne se retrouve encore et s'accentue davantage chaque jour entre Québec et le groupe acadien des provinces maritimes. Jetez les yeux sur les cantons de l'Est, surtout sur les comtés qui avoisinent la frontière ; depuis que les Canadiens-français s'y sont portés, les autres nationalités sont obligées de s'éloigner peu à peu et de nous céder la place, tant notre force d'expansion est irrésistible. Voyez la vallée du lac Saint-Jean où les groupes s'agrandissent et se multiplient. Voyez surtout la région qui s'étend au nord-ouest de Montréal ; regardez-y surgir comme par miracle ces nombreux établissements dus à la parole patriotique et convaincue, au zèle ardent, au travail infatigable de cet apôtre de la colonisation, l'abbé Labelle. Partout nous nous emparons du sol et nous le conservons.

On jette chaque jour le cri d'alarme ; on dit que le pays se dépeuple, que les Cana-

diens-français s'en vont tous les ans par milliers aux Etats-Unis. On a peut-être raison jusqu'à un certain point; mais il ne faut pas envisager la question sur une seule de ses faces. A côté du courant qui se dirige vers les Etats-Unis, il y a celui qui se divise et pénètre dans tous les coins de notre immense territoire. A part la rivière qui se porte vers un seul endroit, il y a les innombrables ruisseaux qui se répandent partout dans la plaine et qui vont au loin féconder le sol et créer des sources d'eaux vives qui deviendront plus tard autant de lacs profonds et majestueux.

Ce qu'il faut constater, dans tous les cas, c'est que nous ne perdons pas de terrain. Malgré la déperdition que nos dispositions pour les aventures et les déplacements peuvent nous causer, nous maintenons l'équilibre avec les autres nationalités qui ont cependant pour les aider l'apport d'une immigration constante venant du Royaume-Uni. Ah! si, au lieu d'être livrés à nos seules ressources, nous avions, nous aussi, le secours de notre mère patrie! Si nous pouvions réussir à amener dans notre pays un élément nouveau de puissance et de vigueur! Si nous pouvions attirer à nous cette population saine, morale, travailleuse des vieilles provinces de France, qui va tous les ans s'engouffrer et se perdre dans le tourbillon des grandes villes, quelle force nouvelle, quelle impulsion irrésistible nous acquerrions! Mais on nous dit, à ce sujet, que le climat est contre nous. Ce n'est pourtant pas un climat si sévère, ce n'est pas un pays si malsain qui nous a permis à nous, Français aussi, non pas seulement de vivre, mais de grandir, de nous développer depuis trois siècles, dans des conditions bien plus difficiles qu'elles ne le sont aujourd'hui. Et, en dehors de cette objection du climat — dont notre exemple fait promptement justice — quel pays pourrait mieux convenir à une immigration venant de France? En quel autre endroit ces émigrants trouveront-ils comme ici des frères parlant leur langue et prêts à leur ouvrir les bras? Où pourra-t-on leur offrir, comme chez nous, leurs anciennes lois, les habitudes, les traditions du foyer, et jusqu'à ce clocher de la paroisse chrétienne et catholique à l'ombre duquel ils sont, comme nous, accoutumés de vivre et de vieillir.

Appelons donc de tous nos vœux ce renfort si précieux qui doit tourner au bénéfice des uns et des autres et tout à l'avantage de notre race.

Quoi qu'il en soit, cependant, et avec ou sans l'aide d'une immigration congénère, le mouvement progressif continue et s'accomplira en dépit même des efforts que font certaines personnes pour l'enrayer. Nous avons prouvé depuis longtemps notre vigueur, notre vitalité. Nous avons montré à tous ceux qui ont voulu nous écraser que nous sommes d'une race qu'on ne dompte pas plus par les menaces que par les cajoleries; que nous sommes d'un sang que les contacts ne peuvent pas altérer et qui conserve à travers les âges toute la chaleur, toutes les impulsions chevaleresques de ceux qui nous l'ont transmis. L'Angleterre sait maintenant, Dieu merci, qu'elle n'a pas de sujets plus loyaux que nous; mais ce qu'elle sait également, c'est que si nous n'avons jamais hésité à lui faire un rempart de nos poitrines, à verser notre sang pour elle sur les champs de bataille, il y a une chose que nous ne céderons jamais, même au prix de notre vie, c'est notre langue et notre foi, c'est notre titre et notre cœur de français.

Du reste, maintenant, les grandes luttes semblent finies; l'apaisement se fait partout. Nous vivons sous un régime qui nous assure toutes les libertés que nous demandions. Nous sommes nos propres maîtres, dans les limites de la justice et du droit; et, s'il n'y a que nous pour créer des embarras et des dissensions, l'ordre social ne sera pas troublé de

longtemps. Nous aimons la paix dans ce travail qui fortifie les corps et élève les intelligences. S'il fallait souffrir et lutter encore, nous serions prêts à souffrir et à lutter.

Mais je crois que nous pouvons envisager l'avenir avec calme et confiance, et continuer à nous développer librement dans ce pays de liberté, à l'ombre de la bannière sur laquelle est inscrite cette grande et noble devise qui nous à faits ce que nous sommes, qui nous fortifiera dans la prospérité comme elle nous a soutenus dans les jours d'épreuve : " Nos institutions, notre langue et nos lois."

VIII — *L'Angleterre et le clergé français réfugié pendant la Révolution,*

Par L'ABBÉ BOIS.

(Lu le 27 mai 1885)

Auferetur a vobis regnum Dei et dabitur
genti facienti fructum ejus.
S. MATTH. XXI, 43.

La tourmente révolutionnaire de la fin du siècle dernier, en chassant les prêtres qui ne voulurent pas souscrire à la constitution civile du clergé, eut l'admirable effet de répandre sur le reste du continent européen les nobles débris du clergé français, si instruit, si bien discipliné, si vertueux, et qui s'épura encore davantage au creuset des tribulations.

L'Angleterre qui, jusque-là, s'était montrée si intolérante vis-à-vis du clergé catholique, et qui avait constamment refusé, malgré les instances des évêques de Québec, de laisser passer au Canada quelques prêtres français pour y venir au secours d'un clergé insuffisant, — l'Angleterre, disons-nous, ne put résister à la vue des immenses infortunes que son hospitalité ne refusa pas de soulager dans ces jours pénibles. La générosité anglaise se montra d'une manière admirable en cette occurrence, et passa des particuliers jusqu'aux régions officielles du gouvernement, milieu pourtant si difficile à émouvoir.

Cette générosité ne resta pas sans récompense. L'Angleterre ressentit les heureux effets du séjour de tant de prêtres catholiques, qui y furent des modèles de vertu. C'est de cette époque qu'il faut faire dater le mouvement si remarquable de retour à la foi de ses pères qui s'est produit dans la nation anglaise.

Le Canada fut le premier à se ressentir de cette modification dans les dispositions de l'Angleterre. Tout le monde sait quelles précieuses acquisitions, soit temporaires, soit définitives, ce double mouvement de la Révolution française et de l'hospitalité anglaise nous a permis de faire.

Malgré l'intérêt qu'il y aurait à suivre en détail l'histoire des vénérables prêtres qui, chassés de la France, vinrent travailler ici, dans un autre champ français, les limites qui s'imposent à un travail du genre de celui-ci, nous obligent à nous borner. Nous nous contenterons, pour cette fois, de rappeler en abrégé les actes de générosité dont a fait preuve la nation anglaise à l'égard des émigrés français, victimes de la Révolution, et de remettre en mémoire les documents, soit inédits, soit oubliés, qui constatent les efforts officiels faits en Angleterre et au Canada pour fonder, dans ce dernier pays, des colonies de réfugiés français de toutes classes, tant laïques qu'ecclésiastiques.

I

Après le décret de proscription du mois d'août 1792, le nombre des prêtres qui émigrèrent en Angleterre s'élevait, au mois de septembre de la même année, à plus de 3,000.

Les années suivantes, ce nombre augmenta jusqu'au chiffre de 8,000. Si l'on joint à ce nombre les religieuses, la noblesse et les autres classes d'émigrés laïques, on comprendra la grandeur des besoins d'une population qui, en outre, arrivait à peu près dénuée de tout.

La Providence, comme autrefois pour les enfants de Jacob, avait envoyé en avant d'elle un homme dont le nom reste identifié avec cette lamentable histoire de l'émigration française en Angleterre. Mgr de la Marche, évêque de Saint-Pol-de-Léon, avait été obligé de quitter la France dès l'année 1791. Avec beaucoup de difficultés, il réussit à arriver en Angleterre. Son mérite personnel, aussi bien que la noblesse de son origine et la dignité dont il était revêtu, le firent admettre dans la première société anglaise, où il se fit un grand nombre d'amis dévoués qui lui conservèrent jusqu'à sa mort les plus chaudes sympathies. Parmi ces amis illustres, citons lord Arundel, le duc de Portland, le marquis de Buckingham, le célèbre orateur Edmund Burke, l'honorable John Wilmot, membre du parlement, et autres. Ces relations avec la noblesse anglaise lui fournirent d'abondantes ressources et lui permirent de devenir comme l'âme du mouvement de secours qui se fit pour ses compatriotes émigrés.

En 1792, à la sollicitation de Mgr de la Marche, M. Edmund Burke rédigea une adresse au peuple anglais demandant une souscription pour les réfugiés français ; cette adresse fut publiée par tous les journaux, et produisit au-delà de 840,000 francs. Au nombre des zélés promoteurs de cette souscription on remarque M. Wilmot et sir Philip Metcalfe, le père de sir Charles Metcalfe, qui a été gouverneur du Canada. Si considérable que fût la somme recueillie, elle ne permit de pourvoir qu'aux premières nécessités, tant les besoins étaient grands.

L'année suivante, nouvelle souscription. Cette fois, le roi Georges III voulut y inscrire son nom le premier. Elle produisit 1,032,000 francs. Parmi les noms accolés aux sommes les plus considérables se trouvent ceux du marquis de Buckingham, de lord Arundel, de Burke, de MM. Stanley, Wilmot, Scott, Gregory, etc. En dehors de ces souscriptions, qui se continuèrent durant plusieurs années, beaucoup de hauts personnages et de riches nobles anglais recueillirent chez eux un certain nombre de prêtres émigrés. Le château royal de Winchester fut consacré par le gouvernement à la même bonne œuvre, et pendant plusieurs années ce château logea huit cents ecclésiastiques français.. Lorsque, en 1797, le gouvernement eut besoin du château de Winchester, les prêtres qui y habitaient furent fournis de logements à Reading, à Thame et à Paddington, où l'on pourvut à leurs besoins avec la plus grande bienveillance. Et combien de dons particuliers faits de la main à la main, sans que souvent le donataire ait pu connaître son généreux bienfaiteur ! La charité à l'égard des prêtres émigrés se fit sentir sous une autre forme non moins délicate ; l'université d'Oxford fit imprimer, à ses frais, une édition du Nouveau-Testament, pour le faire distribuer à ces généreux confesseurs de la foi, qui avaient perdu tous leurs livres dans la tourmente. Le marquis de Buckingham en fit également imprimer une autre édition pour le même but.

Mais on comprit bien vite que les dons des particuliers, si considérables qu'ils fussent, ne pourraient suffire à des besoins sans cesse renaissants, et qui allaient même en augmentant ; il fallait nécessairement trouver quelque autre secours additionnel.

Déjà, en 1792, on avait émis l'idée de fonder au Canada des colonies composées d'émigrés français. Une petite brochure fut même imprimée à Londres, en 1793, portant pour titre : *Proposals for a subscription to form colonies in Canada of French emigrants loyalists*

and ecclesiastics, by Charles Grant, viscount de Vaux. Cette souscription fut commencée, et l'auteur, prêchant d'exemple, fut un des premiers souscripteurs.

Cette idée ne pouvait pas s'exécuter du jour au lendemain, et demandait du temps. En attendant qu'elle prit plus de consistance et pût se réaliser, le gouvernement impérial, sur la proposition de Burke, que déjà l'on appelait "l'ami des Français malheureux," accorda, à la fin de 1783, un fort octroi en faveur des victimes de la Révolution réfugiées en Angleterre. Pareille allocation fut renouvelée annuellement pendant bon nombre d'années pour le même objet, et l'on a calculé que, jusqu'en 1806, il a été distribué aux émigrés français, tant laïques qu'ecclésiastiques, un total de 46,620,000 francs, c'est-à-dire, au-delà de $9,000,000. La répartition des allocations gouvernementales fut confiée à un bureau de direction présidé régulièrement par M. Wilmot. Tous les nécessiteux étaient classés, et chacun recevait chaque année proportionnellement à son rang ; ainsi, parmi eux, trente-huit évêques touchaient une somme relativement plus forte. Ce bureau abandonna bientôt à l'évêque de Saint-Pol-de-Léon, Mgr de la Marche, la gestion des sommes affectées au clergé, et le banquier Wright fut autorisé à payer toutes les traites qui lui étaient présentées au nom de l'évêque de Saint-Pol.

En présence d'une générosité si magnifique, et qui se répandait avec une si grande largeur de procédés, nous ne pouvons nous empêcher de reproduire ici une belle page de reconnaissance envers la nation anglaise, écrite par le cardinal de la Luzerne :

"Tandis que la France, jusque-là si catholique et prétendant l'être encore, persécutait avec fureur les pasteurs catholiques, l'Angleterre, livrée depuis deux siècles au schisme et à l'hérésie, les accueillait avec humanité, se faisait le modèle du monde entier par sa générosité, comme elle en était le soutien par sa puissance. Quel touchant spectacle, quel admirable exemple a donné aux autres nations cette nation hospitalière, quand on l'a vue tout entière, clergé et laïques, roi et sujets, grands et petits, accourir au-devant des confesseurs d'une religion qui n'était pas la sienne, s'empresser de les accueillir, de soulager leurs douleurs, de subvenir à leurs besoins, d'en adoucir les maux ! Daigne Celui qui seul a dans sa main le digne prix de tant de bienfaits, lui en accorder les récompenses les plus abondantes, et surtout celle qui est la plus précieuse et la plus désirable ! Puissent les aumônes de ce peuple bienfaisant monter, comme celle de Corneille, jusqu'au trône céleste, en faire descendre sur lui le don inestimable de la foi !" [1]

Nous ne devons pas omettre de dire qu'un grand nombre d'ecclésiastiques réfugiés français, refusèrent par délicatesse les subsides qu'on leur offrait avec tant de cordialité, parce qu'ils pouvaient absolument se pourvoir eux-mêmes. Quelques-uns s'adonnèrent à des travaux manuels ; d'autres se livrèrent à l'enseignement et à divers autres genres d'occupations qui leur fournissaient le nécessaire. Plusieurs, ayant pu sortir d'embarras par leur industrie, remirent les secours qui leur avaient été accordés ; d'autres, qui purent effectuer leur retour sur le continent, firent, quand ils le purent, passer des secours à Mgr de Saint-Pol-de-Léon, en reconnaissance de l'aide qu'ils avaient eux-mêmes reçue.

Au reste, les prêtres français se montrèrent dignes de la sympathie qu'on leur témoigna. Leur conduite sur la terre d'exil fut vraiment admirable. En présence d'une population naturellement imbue de préjugés contre eux et leur profession, ils surent se

[1] CARD. DE LA LUZERNE, Œuvres complètes. Tome II, p. 914.

concilier l'estime et le respect universels, et ils firent tomber, par leur modeste réserve et la sainteté de leur vie, tous les préjugés qu'on pouvait avoir contre eux.

Disons, pour terminer cette partie de notre travail, que, de 1792 à 1800, la mort enleva plus de 1,250 des prêtres français réfugiés en Angleterre, y compris au moins 16 évêques. Un certain nombre d'autres purent, pendant la même période, quitter l'Angleterre et se rendre en Italie, en Allemagne, aux Etats-Unis d'Amérique, et même au Canada, où Mgr Hubert finit par obtenir l'autorisation du gouvernement pour ceux qui voulurent se rendre dans cette province. Aussi, en 1800, sur les 8,000 prêtres réfugiés, il n'en restait plus que 4,000. Deux ans plus tard, le nombre en était réduit à 900, et il continua ensuite à diminuer rapidement.

II

Comme nous l'avons dit plus haut, Mgr Hubert, évêque de Québec, avait réussi à obtenir l'autorisation du gouvernement impérial de faire venir au Canada quelques prêtres réfugiés français. Pour mieux accentuer le changement que les excès de la Révolution française avaient produit dans les esprits en Angleterre, il est bon de rappeler ici que non seulement on y avait repoussé les demandes réitérées des évêques Briand, Desgly et Hubert, mais que même on avait impitoyablement forcé à s'en retourner quelques missionnaires, comme MM. Capel, Ciquard et autres, qui étaient venus d'eux-mêmes offrir leurs services.

Aussitôt qu'il eut reçu une réponse favorable du gouvernement anglais, Mgr Hubert s'entendit avec les séminaires de Québec et de Montréal, et fit passer à Londres quelques fonds pour défrayer les dépenses qu'occasionnerait le transport au Canada de quelques prêtres émigrés français. Les ressources restreintes de l'évêque de Québec ne lui permettaient d'envoyer que peu à la fois, et ne se prêtaient pas au gré de ses désirs, qui n'aspiraient à rien moins qu'à doubler le clergé de son diocèse. Néanmoins la démarche de Mgr Hubert, qui n'assurait que le placement d'une douzaine d'ecclésiastiques, auxquels l'évêque devait subvenir, fit concevoir au cabinet impérial l'idée de former au Canada une petite colonie composée d'émigrés français des deux ordres, et d'y demander d'abord un asile permanent pour le plus grand nombre possible de prêtres et de laïques.

Cette idée, que s'empressa d'adopter le célèbre Edmund Burke, fut proposée à l'approbation du roi et fut gracieusement agréée. Comme un semblable projet devait nécessairement exiger du temps, on travailla immédiatement à son exécution sans perdre un moment ; pour cela on jeta les yeux sur M. l'abbé Philippe-Jean-Louis Desjardins (l'aîné), vicaire général d'Orléans, réfugié en Angleterre depuis septembre 1792.

Dès son arrivée à Londres, où sa réputation l'avait précédé, M. Desjardins avait trouvé sa place dans ce cercle d'hommes éminents dont Mgr l'évêque de Saint-Pol-de-Léon était le centre. Ses rares qualités l'y firent bientôt distinguer, et deux mois à peine après son arrivée, le 8 novembre 1792, il était élevé au rang de vicaire général du vicariat apostolique du district de Londres. Edmund Burke comprit que le gouvernement ne pouvait confier à de meilleures mains le soin d'aller au Canada traiter avec les autorités provinciales de l'important projet de colonisation des émigrés français. M. Desjardins fut donc nommé commissaire, et, de concert avec deux autres prêtres, M. Jean-André Raimbault mort au Canada en 1813, (curé de la Pointe-Claire), et M. Pierre Gazelle, docteur en Sor-

bonne, chanoine de l'église cathédrale de Genève (que sa santé obligea de retourner en Europe après un séjour de quatre années au Canada.) On leur adjoignit un laïque, canadien de naissance, M. le chevalier François-Josué Saint-Luc de la Corne, de l'ordre royal de Saint-Louis (mort à l'Hôpital-Général de Québec de la manière la plus édifiante, le 15 décembre 1810). Ce fut l'évêque de Saint-Pol-de-Léon qui rédigea le mémoire que ces messieurs devaient emporter avec eux, et qui contenait l'objet de leur mission. Ce mémoire est daté du 8 décembre 1792. (Voir les pièces justificatives.)

Le même jour, le secrétaire d'Etat pour l'Intérieur, sir Henry Dundas, fit remettre à M. Desjardins une lettre qui l'informait qu'il eût à s'embarquer, sous le plus bref délai, avec ces trois compagnons (on ne leur donnait que vingt-quatre heures à Londres pour faire leurs malles et préparer leur long voyage), sur le paquebot de Sa Majesté, le *Portland*, prêt à faire voile pour New-York. On lui recommandait de se présenter, dès son arrivée en cette ville, à l'agent consulaire de la couronne d'Angleterre, sir John Temple, qui lui donnerait les renseignements les plus sûrs pour continuer son voyage jusqu'à Québec. M. Desjardins était porteur d'une lettre qu'il devait remettre en toute diligence au lieutenant-gouverneur à Québec, le major général sir Alured Clarke; puis il devait s'entendre avec Son Excellence sur les divers points qui y étaient traités.

Les quatre commissaires se mirent en route sans retard pour Falmouth, lieu de l'embarquement, où ils reçurent, le 12 décembre, divers autres documents nécessaires à leur mission, comme passeports, instructions privées, etc. Mais le vaisseau ne put mettre à la voile qu'au bout de neuf jours, ce qui fut cause de dépenses imprévues et pas assez en rapport avec leur mince budget.

Arrivés à New-York, le 8 février 1793, les commissaires se rendirent immédiatement auprès de sir John Temple, à qui ils présentèrent leurs papiers, firent part de l'objet de leur mission et demandèrent les avis et conseils dont ils avaient besoin; ils lui exposèrent en outre leur embarras financier, causé par des circonstances tout à fait indépendantes de leur volonté. Ils avaient reçu, avant de partir de Londres, chacun vingt-cinq livres sterling pour se procurer le linge, les habits indispensables, et pour les autres dépenses de voyage. On voit, par le compte rigoureux qu'ils tenaient de leurs dépenses, jusqu'où ils portaient le scrupule pour ne se donner que le nécessaire. Or, quelque parcimonieux qu'ils fussent, il leur était impossible, avec ce qu'ils possédaient, de se rendre à Québec à cette saison de l'année et à une époque où les moyens de communication étaient non seulement très pénibles, mais surtout fort dispendieux. Sur les conseils de sir John Temple, ils se décidèrent à tirer, sur le ministre des finances en Angleterre, une traite qui leur permît de continuer leur voyage jusqu'au terme. Cette démarche prouve jusqu'où allait la confiance qu'ils reposaient dans la générosité et la bienfaisance des ministres d'Etat.

Munis des instructions du consul anglais, les délégués s'acheminèrent vers le Canada; et, le 2 mars 1793, ils étaient rendus à Québec.

La *Gazette de Québec* du 7 mars annonçait leur arrivée en ces termes:

"La semaine dernière sont arrivés en cette ville trois prêtres français, réfugiés de France, venus d'Angleterre à la Nouvelle-York, dans le paquebot du roi. Les recommandations de sir Henry Dundas leur méritèrent un accueil distingué de la part de Son Excellence le major général Alured Clarke, lieutenant-gouverneur de Sa Majesté au Canada C'est le lendemain de leur arrivée, le 3 mars, qu'ils eurent l'honneur d'être présentés à ce

haut dignitaire, au château Saint-Louis. Quelques jours plus tard, M. Desjardins fit remettre au chef de l'exécutif un mémoire exposant l'objet de sa mission."

MM. Desjardins, Gazelle et Raimbault s'étaient empressés, dès leur arrivée, d'aller présenter leurs hommages à Mgr Hubert, l'évêque de Québec. Ils le trouvèrent toujours actif, quoique souffrant alors des accès fréquents de fièvres tremblantes, contractées pendant son séjour dans les missions du Haut-Canada. Si ces messieurs furent singulièrement édifiés de sa paternelle conversation, l'évêque de Québec éprouva, de son côté, une bien grande joie en bénissant ces vénérables proscrits, vrais confesseurs de la foi, appelés depuis si longtemps par ses vœux les plus ardents ; il était d'autant plus heureux que M. Desjardins donnait à espérer que, dès le mois de juin suivant, de 150 à 200 prêtres pourraient venir au Canada, si ses démarches réussissaient.

Ils fixèrent leur résidence au collège des jésuites, qui, hélas ! contenait alors bien des chambres vides. Plus tard, M. Desjardins résida au séminaire de Québec.

Le lieutenant-gouverneur s'était montré très sympathique à la cause que venaient plaider les quatre délégués. Dès la première entrevue qu'il eut avec eux, il insista beaucoup sur l'importance qu'il y avait à ce que les nobles émigrés qui adopteraient le Canada pour patrie, s'y livrassent à l'agriculture ; il dit qu'on pourrait leur donner de bonnes terres, et les distribuer par groupes ou petites colonies, afin qu'ils pussent s'aider, se consoler et s'assister mutuellement.

Dès le 12 mars, sir Alured Clarke réunit le conseil exécutif, et fit lire le mémoire relatif à la mission des quatre envoyés, et exposa ce qu'il leur avait proposé. Sur l'avis du conseil, Son Excellence ordonna au greffier d'écrire à Mgr l'évêque de Québec, à Mgr Bailly, le coadjuteur, à M. Gravé, supérieur du séminaire de Québec, au P. de Berrey, supérieur du couvent des récollets, et aux autres chefs des diverses institutions religieuses du pays, pour leur communiquer les désirs du gouvernement impérial, demander leurs vues à ce sujet et voir jusqu'à quel point ils pourraient y correspondre. MM. Dunn et Baby furent chargés de faire rapport de ces démarches à M. Desjardins et à ses confrères.

Toutes les personnes consultées s'empressèrent d'examiner en quoi elles pouvaient favoriser les généreuses intentions du gouvernement, et répondirent sans délai, offrant tout ce que la misère des temps permettait d'accorder.

Les pères récollets offrirent tout le logement qui était disponible dans leur couvent ou résidence.

Les survivants des ex-pères jésuites mettaient une partie de leurs appartements et ce dont ils disposaient encore de leur ancien collège à l'usage des confrères attendus.

Les messieurs du séminaire de Montréal écrivirent que, malgré les moyens restreints qui leur étaient laissés, ils se chargeraient de douze prêtres auxquels ils fourniraient emploi, pension logement et toutes choses nécessaires à la vie, à l'étude et aux fonctions qui leur seraient assignées.

Les directeurs du séminaire de Québec (malgré l'état de gêne où ils vivaient, pour satisfaire à des obligations qu'ils s'étaient imposées par suite de la fermeture du collège des jésuites) s'engagèrent à donner de l'emploi à quelques prêtres, à en loger d'autres, spécialement à leur maison de la Canardière, où ces prêtres seraient fournis de tous les objets indispensables jusqu'à ce qu'il fût pourvu à leur établissement permanent. Le séminaire offrait aussi sa maison de campagne à Saint-Joachim, pour y loger de même des émigrés français. Quant à quelques secours en argent, il se voyait dans l'impossibilité d'en donner ;

mais si quelqu'un voulait lui prêter la somme de cent guinées, il les mettrait volontiers au fonds des émigrés. Enfin il offrait de concéder aux émigrés français, sans aucune redevance pendant longtemps, fût-ce même cinquante ans, de vastes étendues de terre dans la seigneurie de Beaupré.

Divers particuliers offrirent de mettre à la disposition des émigrés des maisons qui n'étaient pas occupées ; d'autres, quelques appartements dont ils pouvaient disposer, et parfois ces appartements étaient offerts meublés.

Mgr Hubert, dans sa réponse, profita de la circonstance pour réclamer de nouveau les biens des ex-jésuites ; il représenta à l'exécutif combien il serait avantageux à la province et spécialement à la ville de Québec, si l'on venait au secours d'une communauté religieuse se dévouant à l'éducation et à l'instruction publique dans l'intérêt de la ville et des campagnes en lui donnant l'antique collège des jésuites, et lui affectant les revenus des biens de l'ancienne compagnie.

Lorsque le gouvernement fit le dépouillement des réponses qui lui avaient été adressées, il ne put s'empêcher d'admirer l'empressement et la générosité avec lesquels chacun se cotisa largement, eu égard aux modiques ressources que laissaient aux diverses institutions les conditions où elles se trouvaient alors. On constata qu'à leur débarquement soixante et treize prêtres pouvaient être immédiatement accueillis et logés, soit définitivement, soit temporairement, en attendant qu'ils reçussent un poste permanent. Aussi, le 27 mai, le lieutenant-gouverneur et son conseil crurent-ils devoir exprimer formellement leur satisfaction du concours empressé que l'on avait apporté à seconder les vues du gouvernement impérial.

Toutefois ces mesures des grandes corporations n'étaient pas suffisantes. Il fut donc proposé de faire des collectes dans les églises, de prélever des souscriptions dans les villes, de recueillir chez les particuliers, tant des villes que des campagnes, des ustensiles, des meubles, des provisions, et tous autres objets pouvant servir aux familles qui viendraient s'établir dans le pays. Les objets indispensables, lits, linge de lit et de corps, et autres fournitures, devaient être déposés dans les communautés, où ils seraient appropriés et maintenus prêts pour la distribution à faire à ceux qui, en arrivant, en seraient dépourvus.

Après qu'on en eût conféré avec Mgr Hubert, le conseil exécutif arrêta, dans sa séance du 24 mai 1793, que les juges de la cour du banc du roi, les shérifs et les greffiers des tribunaux étaient les personnes les plus compétentes, dans leurs villes et juridictions respectives, pour recevoir les souscriptions des citoyens en faveur des émigrés français, aussi bien que pour donner à ceux-ci les avis, les informations et les secours nécessaires, conformément aux dispositions qu'adopteraient le gouverneur et son conseil. Communication de ces arrangements fut donnée à l'abbé Desjardins, qui en exprima sa bien vive reconnaissance ainsi que celles de ses confrères.

Toutes ces mesures créèrent un admirable entrain de charité dans toutes les classes de la société, entrain qui se soutint pendant plusieurs mois. Tous les jours, disent les contemporains, on voyait éclore quelque nouvelle proposition, quelques nouvelles offres de service. Un ancien prêtre du séminaire de Québec disait que des pauvres, qui n'avaient absolument rien à donner, venaient d'avance offrir leurs services pour le transport gratuit des effets des émigrés.

M. H. Finlay, membre du conseil exécutif, faisant les fonctions de secrétaire, reçut

ordre de donner à M. Desjardins et à ses trois confrères une liste des cantons ou townships disponibles dans la province, avec prière de faire choix de deux de ces cantons, puis de requérir de M. Holland, arpenteur général de la province, tous les détails qu'ils jugeraient utiles touchant l'étendue et la qualité des terrains mis à leur disposition et sur lesquels ils auraient arrêté leur choix. La liste qui leur fut présentée contenait les noms des townships suivants : Frampton, Tring, Waterford, Armagh, Rawdon, Wickham, Hemmingford, Hinchinbrooke, Chatham, Clifton, Grenville, Suffolk, Buckingham.

Cependant, M. le grand vicaire Desjardins n'avait pas oublié la recommandation qui lui avait été faite de se mettre en rapport avec le lieutenant-gouverneur du Haut-Canada, sir John Graves Simcoe, qui depuis deux ans résidait dans cette province, cherchant à y attirer le plus de colons qu'il pouvait, soit des Etats-Unis, soit des autres parties de l'empire britannique. Quoique la similitude de langage et de croyance eût, dans le principe, porté les autorités anglaises à diriger la mission des quatre envoyés vers le Bas-Canada, toutefois, soit dans le dessein de leur offrir un local plus spacieux sous un climat moins rigoureux, soit pour accélérer la colonisation du Haut-Canada, dont la population à cette époque ne dépassait guères 12,000 âmes, on leur avait conseillé de ne pas faire de choix définitif sans avoir pris les informations nécessaires touchant la province supérieure.

Aussi, dès le mois de mai 1793, M. Desjardins s'était-il mis en correspondance avec sir John Simcoe, par l'entremise de M. le shérif McDonell ; et, de concert avec ses collègues, il avait envoyé, pour l'information de Son Excellence, un mémoire exposant le but de sa mission.

Le lieutenant-gouverneur du Haut-Canada se montra extrêmement bienveillant ; il fit de suite inviter un de ces messieurs à se rendre auprès de lui, offrant de lui procurer un passage gratuit sur un des vaisseaux du roi, de Kingston à Niagara, où il faisait sa résidence. Au mois de juillet, il écrivit lui-même au grand vicaire Desjardins, l'invitant personnellement à aller se concerter avec lui pour hâter le succès de sa mission ; il lui offrait de faire des établissements ou de petites colonies françaises, selon les vues du cabinet de Saint-James, sur les rives des lacs Erié et Ontario, ou sur les bords des rivières navigables qui s'y jettent.

Cette lettre, " effusion d'une âme noble et généreuse," écrivait M. Desjardins, le détermina à faire le voyage du Haut-Canada. Il en laissa une copie à Mgr Hubert, qui s'intéressait si vivement au succès de sa belle œuvre, et il en expédia une autre aux Français réfugiés à Londres, afin de les encourager en leur montrant que la magnanimité anglaise, qui les avait consolés en Angleterre,, se faisait aussi sentir en Amérique dans toute son énergie. Il semble que dès lors l'abbé Desjardins craint un refroidissement de zèle de la part de ses compatriotes relativement à leur émigration au Canada. Il commençait déjà à s'attacher au pays ; ce qu'il en avait vu lui faisait comprendre les avantages que pouvaient y trouver les réfugiés français et surtout les prêtres. Tout en étant heureux de pouvoir procurer paix et asile à un grand nombre de confrères et de compatriotes, il était également agréable à son cœur de prêtre de supputer les avantages que devait assurer à la colonie canadienne une immigration de personnes instruites, dévouées et mettant leurs services au profit de l'enseignement et de l'agriculture au Canada. Aussi, dans la réponse qu'il fit à sir John Simcoe, le 28 juillet 1793, une pensée de découragement commence à percer ; il ne peut se défendre d'une idée qui déconcerte ses plans et qui va para-

lyser probablement le mouvement en faveur des émigrés français. On lit en effet, dans cette lettre, les lignes suivantes : " Les événements de la guerre présente, si satisfaisants d'un côté, contrarient de l'autre nos espérances, et nous commençons à ne pas compter sur la venue d'un grand nombre de Français en ce pays..." Aussi, comme il le dit lui-même, est-ce "encouragé par son inclination naturelle plus qu'attiré par les prévenances de Son Excellence" qu'il se décide à partir pour le Haut-Canada.

Ce fut le 3 août 1793, que M. Desjardins et le chevalier de la Corne se mirent en route pour la province supérieure. Les deux délégués furent reçus avec la plus grande cordialité. Le général Simcoe ne se contenta pas de favoriser leur mission diplomatique, mais il se montra à leur égard rempli d'attentions et d'urbanité, et les pressa même de renouveler leur visite au siège de son gouvernement. Ils firent un séjour de plusieurs semaines dans la capitale du Haut-Canada, et, quand ils partirent, ils laissèrent après eux les impressions les plus favorables. On voit par deux dépêches adressées au lieutenant-gouverneur, l'une le 1er et l'autre le 19 septembre, qu'ils avaient demandé un octroi de terres dans Burlington Bay, suivant le bon plaisir de Son Excellence, et qu'ils avaient indiqué ce que devait coûter le débarquement à York de plusieurs familles. Les délégués se mettaient à la disposition de Son Excellence pour tout service future utile à l'œuvre commencée. M. Desjardins, qui se proposait d'aller en Europe le printemps suivant, s'offrait à servir lui-même de guide à ceux de ses compatriotes qui consentiraient à venir chercher une autre patrie sous les auspices de Son Excellence. Enfin les deux délégués terminaient leur lettre en protestant qu'ils emportaient avec eux le souvenir ineffaçable de la bienveillance dont ils avaient été comblés par le lieutenant-gouverneur et par Mme Simcoe. Sir John Simcoe se montra, de son côté, disposé à accorder tout ce qu'on lui demandait.

A leur retour les délégués dressèrent un rapport qui résumait toutes leurs observations et qui se trouve aux pièces justificatives. M. Desjardins s'empressa d'expédier le résultat détaillé de ses démarches aux ministres de la couronne à Londres. Il envoya aussi des copies de son rapport à ses compatriotes demeurés en Angleterre et qui attendaient avec hâte l'issue de sa mission. La relation favorable qu'il leur fit était très encourageante ; aussi lui répondirent-ils en témoignant qu'ils iraient avec plaisir s'établir dans le Haut-Canada. Hélas ! " le réveil de leurs espérances du côté de leur patrie" devait empêcher la réalisation de ce projet, comme l'avait prévu M. Desjardins, et comme il l'écrivit plus tard à sir John Simcoe.

Le 24 septembre 1793, était revenu à Québec le gouverneur-général, lord Dorchester, absent de la colonie depuis le 17 août 1791. M. Desjardins s'empressa, aussitôt qu'il fut de retour de son voyage à Niagara, d'aller lui rendre ses devoirs et de lui soumettre un état détaillé des affaires de sa mission. Il fut très bien reçu par le gouverneur général, qui sut l'apprécier dès la première entrevue. M. Desjardins profita de cette bonne disposition de lord Dorchester pour lui présenter, quelques jours plus tard, un mémoire en faveur de MM. les abbés, Ciquard et Chicoineau, tous deux résidant momentanément à Baltimore, mais qui désiraient venir exercer le saint ministère au Canada. M. Ciquard était déjà venu en cette province, à la demande de M. Montgolfier, supérieur du séminaire Saint-Sulpice de Montréal ; mais n'ayant ni passeport, ni autorisation du gouvernement, dans un temps où l'Angleterre ne voulait permettre à aucun prêtre français de venir au Canada, il avait dû céder à la force et s'en retourner. Cette fois, M. le grand vicaire Des-

jardins pouvait répondre de ses dispositions, et il obtint facilement l'autorisation voulue pour lui et pour son confrère, M. Chicoineau.

Comme il était impossible de faire venir des émigrés avant le printemps suivant, M. Desjardins, qui ne voulait pas perdre son temps, se mit à la disposition de l'évêque de Québec. Mgr Hubert accepta avec un grand bonheur et le mit en mesure d'exercer son zèle apostolique. Cependant le saint missionnaire fut obligé, pendant quelque temps, de suspendre ses travaux ; une fièvre maligne, dont les médecins prétendirent qu'il avait pris le germe dans son voyage du Haut-Canada, le conduisit presque aux portes du tombeau. Pendant cette maladie, qui heureusement ne fut pas très longue, il fut l'objet des attentions les plus délicates de la part de Mgr Hubert ; aussi, à peine convalescent, s'empressa-t-il d'en écrire au charitable prélat et de lui témoigner, avec effusion de cœur, sa vive reconnaissance. Parvenu à la santé, il reprit ses travaux ; il donnait au séminaire, où il avait fixé sa résidence, des conférences sur la théologie et l'Ecriture-Sainte ; il agissait comme directeur et chapelain de l'Hôtel-Dieu, ce qui ne l'empêchait pas d'être en même temps chapelain des congréganistes de Notre-Dame. Son heureux talent pour la parole était souvent mis en réquisition, surtout pour des discours d'apparat ou de circonstance, et il se montrait toujours à la hauteur de l'attente publique ; enfin, il dirigeait au confessional un grand nombre de personnes de la ville. Ces occupations multiples, qui allaient si bien à son zèle sacerdotal, lui faisaient dire qu'il n'avait jamais trouvé le temps plus court que depuis qu'il était constamment occupé.

Le printemps de 1794 arriva. M. Desjardins attendait avec une bien légitime impatience la venue des premiers vaissaux, dans l'espérance de serrer la main à de nombreux compatriotes, et de pouvoir réaliser les projets si bien préparés. Cette impatience toutefois renfermait un mélange d'inquiétude, car M. Desjardins avait, comme nous l'avons déjà dit, une espèce de pressentiment de ce qui devait arriver.

Tant que les choses furent au pire en France, les émigrés, laïques et ecclésiastiques, cédant à un moment de découragement, s'étaient résignés à renoncer définitivement à leur patrie et à s'en chercher une nouvelle ; et, dans ce cas, ils eussent été enchantés de venir au Canada. Mais du moment qu'ils commencèrent à entrevoir la possibilité de jours meilleurs pour la France, et, pour eux-mêmes, l'espérance d'y rentrer, toutes les idées de colonisation à l'étranger s'effacèrent promptement de leur esprit, et ils préférèrent courir le risque d'attendre encore dans une condition précaire l'occasion seule de revoir leur pays, plutôt que de se lancer dans une voie qui était l'expatriation pour toujours. Les ecclésiastiques étaient mus par d'autres motifs ; la plupart avaient été arrachés violemment à leurs troupeaux, et l'impossibilité de jamais les rejoindre avait seul pu les faire songer à offrir définitivement leurs services à d'autres contrées. L'espérance fondée de pouvoir travailler de nouveau à la vigne qui leur avait été confiée, suffisait pour faire naître en eux le désir d'aller réparer, dans la mesure de leurs forces et de leurs ressources, les maux incalculables qui étaient venus fondre sur leur chère patrie. Telles furent les causes qui, de 1793 à 1794, suivant les prévisions de M. Desjardins, firent changer la disposition des esprits relativement au Canada, et arrêtèrent le mouvement de colonisation française commencé si favorablement.

L'émigration française fut donc à peu près nulle au printemps de 1794. Ce fut la fin de tous les beaux projets, de tous les élans de charité qui s'étaient maintenus jusque-là. M. Desjardins lui-même comprit que sa mission était finie. Il s'était proposé d'aller con-

duire un groupe de colons français au Haut-Canada ; il dut renoncer à ce voyage, qui n'avait plus sa raison d'être. Il écrivit donc, au mois de juin 1794, au lieutenant-gouverneur, John Simcoe : — "J'ai attendu jusqu'au printemps des émigrés français... je comptais vous les présenter... mon attente a été trompée...." Cette lettre clôt les rapports officiels de M. Desjardins avec le général Simcoe, et termine ce qui a trait à la mission des délégués du gouvernement anglais.

Mgr Hubert, qui s'était bercé, pendant quelque temps, du doux espoir de voir doubler son clergé dans les meilleures conditions de science et de vertus, dut se contenter du petit nombre d'ecclésiastiques qui, libres de tout autre engagement, purent répondre à ses invitations ou à celles de leurs supérieurs, et dont il put payer les frais de voyage. Comme le bon évêque ne put que successivement subvenir à de pareilles dépenses, il en résulta que les prêtres qui consentirent à venir se ranger sous sa houlette n'atteignirent aussi que successivement nos plages.

Nous terminerons ces notes par la liste des prêtres, victimes de la Révolution française, qui vinrent exercer le saint ministère au Canada, soit temporairement, soit jusqu'à leur mort, et qui ont laissé après eux un si suave parfum de vertus sacerdotales :

Date de l'arrivée :	
1791	MM. Alain.
"	Lejamtel de la Blouterie.
1793	Philippe-Jean-Louis Desjardins, V.G.
"	Jean-André Raimbault....mort en 1813.
"	Pierre Gazelle.
"	François Ciquard.
"	Candide LeSaulniers
1794	Louis-Joseph Desjardins.
"	Jean Castanet.
"	Jean-Denis Daulé.
"	François Gabriel LeCourtois.
"	Philippe Nantetz.
"	Jean-Henri-Auguste Roux, P.S.S.
"	Anthelme Malard, P.S S.
"	Antoine-Alexis Molin, P.S S.
"	Jean-Baptiste Thavenet, P.S.S.
"	François Humbert, P.S.S.
"	Claude Rivière, P.S.S.
"	Antoine Sattin, P.S.S.
"	Melchior Sauvage, P.S.S.
"	François-Marie Robin.

Date de l'arrivée :	
1794	MM. Guillaume Desgarets, P.S.S.
1795	Joseph-Pierre Malavergne.
"	Jacques Delavaivre.
"	Claude-Gabriel Courtine.
"	Jean Raimbault.
1796	Jean-Baptiste Chicoineau.
"	Charles-Vincent Fournier.
"	N. Jabouin.
"	Jacques-Guillaume Roque, P.S.S.
"	Antoine Houdet, P.S.S.
"	Jean-Baptiste Saint-Marc.
"	Urbain Orfroy.
"	Antoine Villade.
"	Pierre-René Joyer.
1798	Joseph-Mandet Sigogne.
"	Antoine Champion.
"	Antoine Gaïffe, P.S.S.
1799	Antoine-Amable Pichard.
1806	Jacques-Ladislas de Calonne.
"	Pierre-Bernard DeBorniol.
"	Nicolas-Aubin Thorel.

Total, 42.

IX — *La frontière nord de la province de Québec,*

Par P. DE CAZES.

(Lu le 28 mai 1885.)

En réponse à une adresse de félicitations qui lui était présentée, dans le cours de l'automne dernier, par le conseil de ville de Québec, à l'occasion de son élévation au poste de lieutenant-gouverneur de la province de Québec, l'honorable M. Masson disait :

" J'ai souvent parcouru le chemin de Sainte-Foye, témoin de l'héroïsme de nos ancêtres à tous, et admiré cette incomparable plaine de la rivière Saint-Charles, si merveilleusement encadrée par les Laurentides, et je me suis dit que, au-delà, bien au-delà de ces montagnes, se trouve peut-être, s'étendant jusqu'aux rives de la baie d'Hudson, un champ vaste et productif d'exploitation qui pourra contribuer avant longtemps à la prospérité de la ville de Québec et de toute la province."

Pourquoi l'espoir exprimé par notre lieutenant-gouverneur ne se réaliserait-il point ?

Pourquoi, comme notre province sœur d'Ontario, qui vient d'obtenir une extension considérable de ses limites, n'aurions-nous pas notre part de ces vastes territoires qui s'étendent au nord de nos frontières actuelles ?

Ne sommes-nous pas, nous enfants de la province de Québec, les descendants, les héritiers directs de ces hardis coureurs des bois qui les premiers se sont aventurés dans ces contrées inconnues ?

Ne sont-ce pas nos missionnaires, des jésuites français, qui les premiers ont porté le flambeau de la foi et de la civilisation au milieu des populations sauvages qui les habitent ?

Nous avons des droits acquis sur ces régions, qui ne le cèdent en rien pour la fertilité aux territoires canadien et américain du Nord-Ouest, tout en ayant sur ceux-ci l'avantage d'être bien boisées et copieusement arrosées ; et ces droits, nous aurions tort de ne pas les revendiquer.

Depuis que les paroles citées plus haut ont été prononcées, la législature de Québec ayant agité cette question dans sa session dernière, j'ai pensé qu'une étude sur les faits qui s'y rattachent pourrait n'être pas sans intérêt. C'est ce qui m'a décidé à grouper, bien trop à la hâte malheureusement, une certaine quantité de preuves qui, à mon sens, donnent à la province de Québec des droits indiscutables à la possession des territoires qui de sa frontière nord s'étendent jusqu'à la baie d'Hudson.

Je me contenterai d'envisager le sujet à un point de vue purement historique, jusqu'au jour où les possessions françaises en Amérique ont été cédées à l'Angleterre par le traité de 1763, laissant aux hommes politiques qui auront mission de la débattre, le soin d'en tirer les conclusions.

Après avoir fait l'exposé de chacun des motifs que l'Angleterre et la compagnie de la

baie d'Hudson faisaient valoir à l'appui de leurs prétentions sur les territoires du Nord, je donnerai à l'encontre les raisons sur lesquelles la France se fondait, pour maintenir ses droits sur cette partie du continent américain.

Pendant longtemps la baie d'Hudson fut le sujet de vives contestations entre la France et l'Angleterre, ou plutôt la compagnie de la baie d'Hudson, à qui le roi Charles II avait cédé en 1670 des droits fictifs en ces parages.

Personne n'ignore que cette région fut le théâtre de quelques-uns des faits d'armes les plus mémorables qui aient été enregistrés dans les annales militaires du Canada, sous la domination française ; que là eurent lieu les principaux exploits de LeMoyne d'Iberville, qui valurent au jeune capitaine le surnom glorieux de Cid du Canada.

Les Anglais font remonter leurs droits de possession sur la baie d'Hudson à un voyage de découverte que les frères Cabot firent dans ces parages vers l'année 1498.

En admettant que la mer du Nord ait été visitée par les Cabot, et plus tard même par Henry Hudson, qui, après y avoir passé l'hiver de 1610 à 1611, y périt au printemps suivant, abandonné par son équipage en révolte, par le chevalier Thomas Button en 1612, par Baffin en 1615, et par Fox et James en 1631, rien ne prouve qu'aucun de ces navigateurs, dont le seul objectif était la découverte d'un passage conduisant à la mer des Indes ait fait une prise de possession quelconque de la région qu'elle baigne.

Ces hardis marins, qui poursuivaient un but unique, devaient considérer comme peu avantageuse pour leurs pays la possession de terres qui semblaient ne recéler aucun des métaux précieux dont la découverte faisait l'ambition des navigateurs, à cette époque.

Au reste, cette prétendue découverte de Cabot peut bien avoir eu, au point de vue de l'Angleterre, le même résultat que celle de Terre-Neuve faite en 1491 par le même navigateur, et qui n'en fut pas moins acquise à la France trente-quatre ans plus tard (1525) par la prise de possession de Verazzani, au nom du roi François Ier.

Depuis le jour où Christophe Colomb se vit voler jusqu'au nom du nouveau continent qu'il avait révélé à l'ancien monde, combien, parmi les hardis navigateurs qui le suivirent, ne profitèrent pas des avantages de leurs découvertes !

Voici ce que Charlevoix [1] dit au sujet de la première prise de possession de la baie d'Hudson :

" ...... Mais il est certain que ce fut Henry Hudson, Anglois qui en 1611, donna son nom, et à la Baye, et au Détroit, par où il entra. *On ne scait rien de ce qu'il y fit, on ignore même s'il y pénétra bien avant.* Les prétendus prises de possession de Nelson, de Thomas Button et de Luxfox, faites en divers temps de tout ce pays, quand elles seroient aussi constatées, qu'elles le sont peu, n'établissent pas mieux les droits, que cette Nation (l'Angleterre) s'attribuoit sur cette Baye au tems, dont je parle, que celles de Verazzani sous le règne de François I ne nous donnoit celui de revendiquer la Caroline, la Virginie et les autres Provinces de l'Amérique Septentrionale, qui sont aujourd'hui occupées par la Couronne d'Angleterre, puisqu'il est certain que les Anglois ne possédoient rien aux environs de cette Baye, *lorsqu'en 1656 le Sieur Bourdon y fut envoié pour en assûrer la possession à la France :* Cérémonie qui fut plusieurs fois renouvellée dans la suite."

La première tentative sérieuse d'occupation de la baie d'Hudson par les Anglais n'eut lieu qu'en 1668, et voici en quelles circonstances :

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[1] Vol. I, p. 476.

Deux Français établis au Canada depuis un grand nombre d'années, [1] Chouart de Grozeillers et de Radisson, avaient conçu le projet de faire en grand la traite des pelleteries vers la mer du Nord. Ayant vainement cherché à Québec quelqu'un qui voulût s'associer à leur entreprise, ils passèrent en Angleterre où ils s'adressèrent au prince Rupert, neveu du roi, qui leur fournit les moyens d'entreprendre une expédition dont le commandement fut donné au capitaine Zacharie Gilham.

Cette connaissance des seules ressources que pouvaient offrir les contrées avoisinant la baie d'Hudson semble prouver à l'évidence que les deux aventuriers français avaient déjà visité ces parages. Une note qui se trouve dans le *Journal des jésuites*, à la date du 3 mai 1662, me confirme dans cette certitude, quant à des Grozeillers, au moins.

" Je partis de Québec — y est-il dit — pour les Trois-Rivières. Je rencontrai des Grozeillers qui s'en allait à la mer du Nord."

Il paraît évident aussi que des Grozeillers et son compagnon n'avaient d'autre but, en conduisant les Anglais à la baie d'Hudson, que d'y faire une expédition purement commerciale, et non d'en prendre possession au nom de la Grande-Bretagne. Ce qui le prouverait, c'est que nous voyons, quelques années plus tard, en 1682, les mêmes des Grozeillers et de Radisson se mettre à la tête d'une expédition semblable pour le compte de la compagnie du Nord formée par les marchands de Québec, et s'emparer même d'un fort que les Anglais avaient construit sur la rivière Nelson.

Quoiqu'il en soit, c'est à la suite de cette expédition de 1668 que le prince Rupert obtint du roi d'Angleterre, Charles II, la charte sur laquelle la compagnie de la baie d'Hudson s'est toujours fondée, depuis, pour appuyer ses prétentions sur les territoires du Nord.

Le roi d'Angleterre, en octroyant cette charte, n'a pu avoir l'intention de conférer à la compagnie de la baie d'Hudson des droits qu'il ne possédait pas lui-même. Cette idée est, du reste, manifestement exprimée par la phrase suivante qui s'y trouve : " Nous avons donné, octroyé et confirmé, et par ces présentes donnons et confirmons pour nous, nos héritiers et successeurs, le commerce exclusif de tous les détroits, mers, baies, rivières, lacs, criques et bas-fonds, quelque soit leur latitude, compris entre l'entrée des détroits communément appelés détroits de la baie d'Hudson, avec toutes les terres et territoires situés sur ces contrées, côtes et confins de terre, baies, lacs, rivières, criques et bas-fonds ci-dessus qui ne sont pas maintenant en la possession de quelques uns de nos sujets ou ne leur auront pas été octroyés, *ou ne sont pas en la possession des sujets de quelque autre prince ou Etat Chrétien. ...*"

Cette exception en faveur de tout ce qui pourrait être déjà en la possession des sujets de quelque autre prince chrétien prouve d'une façon assez claire que le roi d'Angleterre ne définissait pas bien exactement la nature de ses prétentions sur la baie d'Hudson et les territoires environnants. Cette charte ne pouvait donc s'appliquer qu'aux terres à découvrir, car sur la question de l'occupation antérieure de ces contrées par la France il ne peut y avoir de doute.

Dans une lettre que le P. Allouez écrivait en 1667 au P. Jacques Cordier, provincial de l'ordre à la Nouvelle-France, sur la mission des Kilistinous, tribus qui vivaient dans les environs de la mer du Nord, il dit :

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[1] M. Sulte, dans son *Histoire des Canadiens-français*, dit que, dès 1645, ce Chouart des Grozeillers était employé, pour le compte des jésuites du Canada, à des voyages de découvertes.

" Les Kilistinous ont leurs demeures plus ordinaires sur les costes de la Mer du Nord ; ils naviguent sur une rivière qui va se descharger dans une Grande Baye que nous jugeons bien probablement celle qui est marquée dans la carte avec le nom d'Hudson, car ceux que j'ay veus de ce païs m'ont rapporté qu'ils ont eu connaissance d'un navire, et un vieillard, entre autres, me dit qu'il l'avait veu luy-mesme, à l'entrée de la rivière des Kilistinous, dont le païs est encore plus au nord.

" Il m'adjousta *qu'il avait aussi veu une maison que les Européens avaient faite en terre ferme, de planche et de pièces de bois. ...*"

Preuve qu'il y avait eu avant cette époque (1667) des terrains occupés sur la baie d'Hudson même, soit *par des sujets anglais, soit par des sujets de quelque autre prince ou état chrétien.*

Or, comme il paraît parfaitement établi que les Anglais n'ont pu faire aucun acte de prise de possession dans ces régions avant 1668, il est supposable que la maison dont il vient d'être question était le poste que les Français avaient construit en 1661, à l'embouchure de la rivière Rupert, qui prit, pour cette raison, le nom de *rivière des Français,* sous lequel elle est le plus souvent désignée sur les cartes anglaises les plus anciennes.

Ce fait est consigné dans un mémoire produit par la Compagnie Française du Canada en réponse à un factum que la compagnie de la baie d'Hudson avait adressé aux commissaires chargés de régler (en 1687) leurs difficultés.

Au reste, la Compagnie anglaise avait une si médiocre confiance dans la validité de sa charte, que vingt ans après l'avoir obtenue (en 1690), elle en demandait la confirmation au parlement, qui la reconnut, *mais pour sept ans seulement.*

A l'expiration du temps fixé, aucune nouvelle demande ne fut adressée au parlement par la compagnie, et jamais, depuis, les privilèges que lui conférait cette charte ne furent renouvelés.

De tout temps, au contraire, nous avons vu la France revendiquer les territoires qui, à l'est et à l'ouest, s'étendaient jusqu'à la mer du Nord.

Je ne donnerai pas plus d'importance qu'il ne faut à la version qui tendrait à dire qu'une petite colonie de pêcheurs bretons était établie dès 1504 sur les rives de la baie d'Hudson, ainsi qu'en ferait foi une carte publiée en 1506 par Jean Denys, de Honfleur, et je ne rappellerai que pour mémoire, les explorations qu'aurait faites en ces parages, vers 1523, Jean Verazzani pour le compte de la France, mon intention étant de ne m'appuyer que sur des documents aussi incontestables que possible.

Marc Lescarbot, qui vint au Canada en 1606 avec M. de Poutrincourt, et qui a laissé un ouvrage très précieux sur les découvertes et les premiers établissements des Français dans l'Amérique du Nord, écrivait à cette époque, c'est-à-dire quatre ans environ avant l'arrivée d'Hudson dans la baie qui porte aujourd'hui son nom :[1] " Ainsi nôtre Nouvelle-France aura pour limites du coté d'Oüest la terre jusques à la mer dite Pacifique, au-deçà du Tropique du Cancer : Au Midi, les îles et la mer Atlantique du côté de Cuba et l'île Hespagnole : Au Levant la mer du Nort qui baigne la Nouvelle-France : *Et au Septentrion, celle terre qui est dite inconuë vers la mer glacée jusques au Pole arctique. ...*"

La description que faisait Lescarbot des bornes de la Nouvelle-France est confirmée, du reste, pour ce qui concerne la limite nord, par divers documents émanant des rois de France.

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[1] *Histoire de la Nouvelle France* par Marc Lescarbot, vol. I, p. 29. — Paris 1866.

Ainsi, la clause 4e de "l'Acte pour l'établissemant de la compagnie des Cent-Associés," datée du 27 avril 1627, se lit comme suit :

" Sa Majesté donnera à perpétuité auxdits Cent-Associés, leurs hoirs et ayants cause, en toute propriété, justice et seigneurie, le fort et habitation de Québec, avec tout le pays de la *Nouvelle-France* dite *Canada*, tout le long des côtes depuis la Floride, que les prédécesseurs Rois de Sa Majesté ont fait habiter, en rangeant les côtes de la mer *jusqu'au cercle arctique*."

En 1632, une carte [1] que Champlain publiait pendant sa captivité en Angleterre, donne à la Nouvelle-France toute la région qui s'étendait au nord jusqu'au pôle.

Quoique les prétentions des rois de France sur le nord de l'Amérique ne fussent pas ignorées en Angleterre, on ne trouve rien qui en fasse mention dans le traité de Saint-Germain-en-Laye (1632). On y voit, au contraire, que le roi d'Angleterre s'engage "à rendre et restituer à Sa Majesté très-chrétienne tous les lieux occupés par les Anglais en la Nouvelle-France, l'Acadie et le Canada."

Enfin, les commissions de M. de Lauzon en 1651, du vicomte d'Argenson en 1657, de M. de Mézy en 1663, et de plusieurs autres gouverneurs du Canada établissent leur juridiction *du côté nord; autant que s'étendent les terres dudit pays.*

Après avoir montré que les prétentions des rois de France sur les possessions de l'extrême nord de l'Amérique n'étaient pas alors contestées par l'Angleterre, je vais tenter de prouver que les Français furent les premiers occupants de ces régions.

Le marquis de Denonville, gouverneur du Canada de 1685 à 1689, écrivait au ministre des affaires étrangères de France :

"En 1656, Jean Bourdon, après avoir longé avec un navire de trente tonneaux la côte du Labrador, pénétra dans la baie du Nord, dont il prit possession. *Ce fait est prouvé par un extrait de l'ancien registre du conseil de la Nouvelle-France, daté du* 27 *août de ladite année.*

"En 1661, des sauvages de la baie du Nord vinrent à Québec, dans le but de confirmer la bonne entente qui existait entre eux et les Français, et pour demander un missionnaire. Le père Dablon s'y rendit par terre avec le sieur de la Vallière et d'autres.

" *Le père Dablon a certifié la chose.* En 1663 ces mêmes Sauvages revinrent à Québec pour prier d'autres Français de venir chez eux.

" Le sieur d'Avaugour, alors gouverneur, envoya le sieur Couture avec cinq autres. Le sieur Couture prit alors possession du fond de ladite baie où il se rendit par terre et y plaça les armes du roi gravées sur une plaque de cuivre."

On a nié quelque part que Bourdon en 1657, le P. Dablon en 1661, et Couture en 1663, se fussent rendus jusqu'à la mer du Nord.

Cependant, en outre de l'autorité fort respectable que je viens de citer, Charlevoix, dans son *Histoire de la Nouvelle-France*, corrobore le fait en ce qui concerne Bourdon, lorsqu'il dit : "Le sieur Bourdon, habitant de la Nouvelle-France, envoyé par le gouverneur-général dans le Nord, entra dans la Baie d'Hudson, *où personne que l'on sache n'avait encore pénétré*, et en prit possession au nom du roi très Chrétien."

D'autre part, je trouve dans le *Journal des jésuites*, à la date du 2 mai 1657 : " M. Bourdon leva l'ancre de Quebec pour le voyage du Nord."

Puis, plus loin, à la date du 11 août de la même année :

" A dix heures du soir, arriva devant Quebec. M. Bourdon de son voyage du Nord."

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[1] Cette carte est reproduite dans le 3e volume des *Œuvres de Champlain*, Québec 1870.

Ce qui prouverait que M. Bourdon a mis trois mois et neuf jours à faire le trajet par mer.

Il est vrai que le peu de détails fournis par le P. Dablon sur la dernière partie de son expédition vers les régions boréales, a pu laisser supposer qu'il ne s'était pas rendu jusqu'à la mer du Nord en 1661 ; mais le document suivant, dont l'original se trouve dans les archives du ministère des affaires étrangères, à Paris, ne peut laisser aucun doute à cet égard.

" Nous, Louis Dablon, prêtre, religieux de la compagnie de Jésus, missionnaire employé à l'ynstruction des nations sauvages de la Nouvelle-France, et Denis de Lavalière, lieutenant d'une compagnie d'ynfanterie entretenüe pour le service de Sa Majesté au dit païs, certifions à tous qu'il appartiendra que les sauvages du costé de la Baye du Nord du Canada estant venus à Québek au mois de juin de l'année 1660 pour demander à monsieur le vicomte d'Argenson, gouverneur de la Nouvelle-France, un missionnaire pour les ynstruire et un officier pour les conduire, nous y serions allez par ordre de monsieur d'Argenson, accompagnez des nommez Denis Guyon, Desprez, Couture [1] et François Pelletier, faisant le dit voyage par terre, et estant arrivez chez les dits Sauvages, ils nous auroient reçu fort humainement et consenti que nous prissions possession de leur païs au nom de Sa Majesté, ce que nous avons fait en y arborant des croix et cotes d'armes de Sa Majesté.

" En Foy de quoi nous avons signez le présent certificat. Fait à Montréal le troisième may 1662.

" Louis Dablon, de la compagnie de Jésus, Denis de Lavalière."

Voici, du reste, ce que le P. Dablon écrivait le 2 juillet 1661 au P. Jérôme Lalemant, supérieur des missions de la compagnie de Jésus à la Nouvelle-France :

" Enfin, avec l'aide de Dieu, *nous voilà rendus presque à my-chemin de la Mer du Nord*, en un lieu qui est comme le centre des deux Mers, de celle que nous avons quittée et de celle que nous cherchons ; puisque en venant de Tadoussac icy nous avons tousiours monté, mais si prodigieusement, que nos Sauvages nous voulant rendre raison des excessives chaleurs dont ces régions sont bruslées, disoient que cela provenoit du voisinage du Soleil, duquel nous avons beaucoup approché, ayant surmonté des saults si hauts et en si grand nombre. D'un autre costé, nous n'avons plus désormais qu'à descendre, toutes les rivières sur lesquelles nous avons à naviguer, s'allant descharger dans la Mer du Nord, comme toutes celles que nous avons passées, se vont rendre à Tadoussac."

Le fait que le P. Dablon désigne le lac Nekouba, d'où il écrivait ce qui précède, comme étant à mi-chemin de Tadoussac à la mer du Nord, prouve de plus que la topographie des lieux ne lui était pas inconnue.

L'authenticité de la prise de possession du sieur Pierre Couture est tout aussi bien établie par deux nouveaux documents provenant des mêmes archives.

Portant la date du 10 mai 1663, se trouve la commission du sieur d'Avaugour, gouverneur de la Nouvelle-France, au sieur Couture, missionnaire, pour aller prendre possession de la baie du Nord, qui se lit comme suit :

" Nous, Jean du Bois, seigneur d'Avaugour, conseiller du roy en ses conseils et gouverneur de la Nouvelle-France.

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[1] Probablement Guillaume Couture, le premier colon de Lévis, dont M. J. E. Roy, rédacteur du *Quotidien*, a dernièrement écrit la vie.

"Avons donné pouvoir à prestre missionnaire sieur Couture[1] de se transporter dans tous les païs habitez par les sauvages de la Baye du Nord et de prendre possession réitérée[2] au nom de Sa Majesté de tous lesdits païs, et ce, en conséquence de la réquisition que lesdits sauvages nous en sont venus faire à Québek par leurs députez au nombre de 15 qui ont témoigné le désir que toutes ces nations ont d'être instruites en la véritable religion et de vivre sous l'obéissance de Sa Majesté.

"Fait à Québek le 10 may 1663.

"D'Avaugour."

Puis, plus loin, le certificat de la prise de possession de la baie du Nord par les sieurs Couture et de la Chesnaye, ainsi conçu :

"Nous, Pierre Couture, prestre, missionnaire entretenu en la Nouvelle-France, et Jacques de la Chesnaye, envoyés par le sieur d'Avaugour, gouverneur de la Nouvelle-France, pour instruire et diriger les sauvages de la Baye du Nord dans leurs affaires, certifions que nous nous sommes transportez chez les dits sauvages par ordre de mon dit sieur d'Avaugour, qu'y estant arrivez, nous avons pris hauteur, y avons planté une croix et pour mieux marquer la possession que nous prenions de leur païs et en laisser des marques à la postérité, nous avons mis en terre au pied d'un gros arbre les armes de Sa Majesté gravées sur du cuivre, enveloppées entre deux plaques de plomb et de l'écorce d'arbre par dessus ; ce que nous certifions véritable.

"Fait à Québek ce premier mars 1664.

"Pierre Couture, La Chesnaye."

Nous verrons maintenant que les rois de France et leurs représentants en Amérique, loin de reconnaitre la charte de Charles II à la compagnie de la baie d'Hudson, n'en tinrent jamais aucun compte. Nous en trouvons la preuve dans un grand nombre de documents provenant de diverses sources, ayant trait à la question qui nous occupe.

Le 2 novembre 1671, c'est-à-dire plus d'un an après la promulgation de cette charte, l'intendant Talon écrivait à son gouvernement à ce sujet :

"Comme ces contrées ont été depuis longtemps et originairement découvertes par la France, j'ai chargé le dit sieur Saint-Simon d'en renouveler la possession, au nom de Sa Majesté, avec ordre d'y élever les armes de France, que je lui ai confiées, et de dresser un procès-verbal en la forme que je lui ai fournie."[3]

D'autre part, quelques années plus tard, le 5 août 1683, Louis XIV. donnait les instructions qui suivent à M. de la Barre, alors gouverneur du Canada : "Je vous recommande d'empêcher autant que possible les Anglais de s'établir sur la baie d'Hudson, dont la prise de possession fut faite en mon nom, il y a plusieurs années, et comme le colonel d'Unguent (Dongan), nommé gouverneur de New-York par le roi d'Angleterre, a reçu des ordres précis de son souverain de se tenir en bonne intelligence avec nous et d'éviter avec soin tout ce qui pourrait la rompre, je ne doute pas que les difficultés que vous ont causées les Anglais ne cessent à l'avenir."

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[1] Ce Pierre Couture, *prêtre missionnaire*, a été confondu, par la plupart de nos historiens, avec Guillaume Couture, interprete, qui vivait à la même époque.

[2] Preuve qu'il y avait au moins eu déjà une prise de possession.

[3] L'expédition dont parle l'intendant Talon est celle à laquelle prit part le P. Albanel, découvreur du lac Mistassini, et le premier qui ait fait une narration circonstanciée de son voyage, que nous trouvons consignée dans les *Relations des jésuites* — année 1672.

Les droits de la compagnie de la baie d'Hudson ne sont pas davantage reconnus dans un traité de neutralité conclu à Londres, le 16 novembre 1686, entre Jacques II et Louis XIV, fixant les limites des possessions des deux souverains en Amérique, et dont la clause XIV est ainsi conçue :

" Le présent traité ne dérogera en aucune manière au traité conclu entre Leurs dites Majestés à Breda, le trente et unième jour du mois de juillet 1667, mais que chacun et tous les articles et clauses du dit traité demeureront dans leur force et vigueur et seront observés."

Or, dans le traité de Bréda auquel il est fait ici allusion, et dans lequel on reconnaît à la France la propriété de l'Acadie, il n'est nullement question de la baie d'Hudson, quoique jamais, jusqu'alors, les rois de France n'eussent perdu une occasion de revendiquer leurs droits sur ces régions.

Puis, quand eut lieu ce traité de neutralité du 16 novembre 1686, le roi d'Angleterre ne pouvait ignorer que, dans le coursde l'été de la même année, le chevalier de Troyes et M.M. d'Iberville, de Sainte-Hélène et de Maricourt, à la tête de soixante-dix Canadiens, s'étaient emparés, sur l'ordre de M. de Denonville, gouverneur du Canada, de tous les postes que les Anglais avaient établis sur la baie d'Hudson, ce qui n'empêche pas que la clause cinquième, qui se lit comme suit, fut agréée par les parties contractantes : " Il est convenu, dit cet article, que chacun des dits rois aura et tiendra les domaines, droits et prééminences dans les mers, détroits et autres eaux de l'Amérique et aura les mêmes étendues qui leur appartiennent de droit et en la même manière qu'ils en jouissent à présent."

Néanmoins, vers ce temps, des plaintes furent portées, tant au roi d'Angleterre qu'à celui de France, par ceux de leurs sujets respectifs qui avaient été victimes des invasions réciproques dont la baie d'Hudson était fréquemment le théâtre. Les deux souverains s'entendirent alors pour nommer une commission chargée d'examiner la nature des griefs qui lui seraient signalés de part et d'autres ; mais les commissaires n'ayant pu s'entendre, Louis XIV donna des instructions en conséquence au comte de Frontenac, gouverneur du Canada.

Voici ce qu'en dit Charlevoix dans son *Histoire de la Nouvelle-France* :[1]

" Dans les instructions, qui lui furent données, (à M. de Frontenac) et qui furent signées le septième de Juin (1689), le Roy lui marquoit que sur les avis, qu'on avoit reçus en France et en Angleterre, des invasions réciproques des Postes établis dans la Baye d'Hudson par les Anglois et les François, il y avait eu à Londres des Conférences entre ses Commissaires et ceux de la Grande-Bretagne ; mais que les Parties n'ayant pu convenir des faits allégués par les Intéressés, on étoit demeuré d'accord de remettre la négociation au mois de Janvier de la présente année 1689 ; que la révolution arrivée pendant ce tems en Angleterre, avoit rompu toutes ces mesures, et que, comme il étoit vraisemblable que les Anglois n'avoient pas encore songé à prendre leurs précautions de ce côté-là, *Sa Majesté souhaitoit qu'il donnât à la Compagnie du Nord toute la protection, dont elle auroit besoin, pour les chasser des Postes, qu'ils avoient usurpés sur elle.*"

Au traité de Ryswick (20 septembre 1697), il fut aussi question des différends qui avaient lieu à la baie d'Hudson. On convint de nommer des commissaires chargés de les

[1] Vol. I, p. 544.

régler. Mais cette commission, si elle siégea jamais, n'en arriva pas plus que celle de 1688 à une décision définitive.

Alors, comme le dit encore Charlevoix, après avoir parlé des règlements qui furent faits touchant d'autres frontières :[1]

" ... Pour ce qui est de la Baye d'Hudson, elle nous resta toute entière, *parce que nous en étions les Possesseurs actuels.* Les Anglois se bornèrent à demander de grands dédommagemens pour ce que nous leur avions enlevé pendant la paix dans les Forts du fond de cette Baye. On leur opposa l'invasion du Fort Nelson faite auparavant, sans qu'il y eût guerre entre les deux Couronnes, et où nous avions souffert une perte beaucoup plus considerable."

Nous voyons qu'ici encore il n'y a rien de réglé.

Les Anglais, du reste, ne réclamaient que des dommages et ne se plaignaient pas d'avoir été dépouillés de leurs territoires.

Il me semble que l'article de ce traité (de Ryswick) qui dit : " Mais la possession des places prises par les Français durant la paix qui a précédé cette guerre, et reprise par les Anglais durant la guerre *sera laissée aux Français*," est tellement explicite qu'elle ne peut donner lieu à aucune erreur d'interprétation et assure sans conteste les droits de la France sur la baie d'Hudson. Jamais les historiens du temps ne l'ont interprété autrement, et la plupart d'entre eux se contentent de dire, sans autres commentaires, que le traité de Ryswick donnait la baie d'Hudson à la France.

Cependant quelque temps après, la compagnie de la baie d'Hudson, essaya de contester aux Français le droit d'établir des maisons, factoreries ou forts au nord des rivières Albany et Rupert, situées, la première sur la côte ouest, et la seconde sur la côte est de la baie. Mais ces prétentions ne leur furent pas reconnues.

Depuis cette époque jusqu'au traité d'Utrecht, nous voyons la compagnie de la baie d'Hudson faire à différentes reprises de nouvelles propositions tendant à faire reconnaître ses droits de propriété sur la partie des territoires située au nord de certaines limites qu'elle spécifiait, demandant ainsi, en 1700, qu'une ligne fût tirée de la rivière Albany, sur la côte ouest de la baie d'Hudson à la rivière Rupert, située sur l'autre côté ; puis, en 1701, de la rivière Albany à la rivière Main ; enfin, en 1711-1712, de la rivière Albany aux rives sud-ouest du lac Mistassini, et de là jusqu'à l'île Grimmington, sur la côte du Labrador.

Après le traité d'Utrecht (1713), qui cédait la baie d'Hudson à la Grande-Bretagne sans spécification de limites, la compagnie devint beaucoup plus exigeante. Se prévalant des hautes influences qu'elle possédait alors en Angleterre, et profitant des embarras dans lesquels se trouvait plongée la France pendant les dernières années du règne de Louis XIV, elle réclama le 49e degré de longitude comme sa limite sud. De son côté, la France prétendit que la frontière entre les possessions des deux pays devait être fixée au 55e degré.

Comme la chose avait eu lieu après le traité de Ryswick, les commissaires nommés pour régler ce différend ne s'entendirent pas, de sorte que chacun des deux pays resta encore une fois avec prétentions respectives.

Cependant, à partir de cette époque, et sans qu'aucune raison satisfaisante puisse être donnée pour expliquer le fait, quelques géographes, s'appuyant sans doute sur des pourparlers qui avaient eu lieu entre les commissaires chargés de fixer les limites commen-

[1] *Histoire générale de la Nouvelle-France*, vol. II, p. 236.

cèrent à donner la hauteur des terres comme la frontière mitoyenne qui devait exister entre le Canada et les possessions britanniques du côté de la baie d'Hudson. Mais il est prouvé que jamais le gouvernement français ne tint compte de cette délimitation.

Chose étrange quoique le différend fût encore pendant, lorsque eut lieu le traité d'Aix-la-Chapelle (1748), on ne voit pas qu'il y fût question de le régler. Cependant il est bien reconnu qu'à cette époque les Français avaient des forts sur la baie d'Hudson et notamment sur la rivière Albany.

Il est non moins prouvé qu'alors la compagnie de la baie d'Hudson n'avait pas encore établi de postes dans l'intérieur des terres. Car, en 1749, un comité de la chambre des communes d'Angleterre ayant été chargé de prendre connaissance des conditions où se trouvait la contrée avoisinant la baie, et du commerce qui s'y faisait, constata que tous les forts et autres établissements de la compagnie étaient situés sur le littoral même de la mer.

Effectivement, déjà depuis longtemps les Français avaient le monopole exclusif de la traite des pelleteries dans l'intérieur des terres à l'est et à l'ouest de la baie, et avaient établi, pour protéger leur commerce, un grand nombre de forts que nous voyons consignés dans les cartes du temps, entre autres dans celle du P. Laure (1731), et de d'Anville (1740).

Vers le milieu du dix-huitième siècle, la compagnie des Indes, qui ne comptait pas moins de trois cents employés à son service, avait des postes dans la vallée de la Saskatchewan, sur la rivière McKenzie, et jusque sur les rives du Pacifique.

Depuis la cession du Canada à l'Angleterre (1763), rien n'a été réglé relativement à la frontière qui doit séparer le Canada des territoires de la compagnie de la baie d'Hudson; et si, d'un côté les actes de Québec de 1774 et de 1791, malgré leur ambiguïté sur la question, semblent donner raison à ceux qui assignent la hauteur des terres comme limites nord du Canada, de l'autre, la commission de lord Durham (1838) paraît établir clairement que la frontière des provinces du Canada d'alors devait être les rives mêmes de la baie.

Vers 1812, lord Selkirk, qui jouissait d'une influence considérable en Angleterre, afin d'affirmer les droits de propriété de la compagnie de la baie d'Hudson dont il était un des principaux actionnaires, vint établir une petite colonie à la Rivière Rouge, et contestant naturellement à la compagnie du Nord-Ouest, qui s'était formée au Canada, le droit de traiter sur les territoires, il entreprit de la détruire. Il s'empara de plusieurs des forts de la compagnie rivale, saisit ses marchandises et fit prisonniers les gens à son service. Mais bientôt les employés de la compagnie canadienne, s'organisant, opposèrent une résistance des plus vigoureuses aux empiètements dont ils étaient les victimes. Il s'ensuivit une série de luttes sanglantes qui durèrent jusqu'au jour (1821) où les deux compagnies se fondirent en une seule.

Il n'y a donc jamais eu entre les possessions de la compagnie de la baie d'Hudson et le Canada qu'une ligne de démarcation imaginaire tracée par une entente tacite entre la puissante compagnie et le gouvernement anglais, mais qui n'a jamais été régulièrement définie.

S'il faut en croire la relation déjà fort ancienne laissée par le P. Albanel qui, en 1672, se rendant à la mer du Nord, a visité le pays jusque vers le 55e degré de longitude, relation corroborée en tous points par l'arpenteur, M. Bignell, qui a exploré ces parages dans le cours de l'été dernier, la possession de ces contrées ne serait pas à dédaigner.

Après avoir décrit le lac Mistassini " qu'on tient estre si grand, qu'il faut vingt jours

de beau temps pour en faire le tour," dans lequel "il y a quantité de très belles isles, du gibier et du poisson de toute espèce," et où "les orignaux, les ours, les caribous, les porcs-épics et les castors sont en abondance." Voici maintenant ce que le révérend père dit des environs du lac Némiskau, situé à mi-chemin du lac Mistassini à la baie James, vers le 51e degré de longitude:

"Le 23. et le 24. nous trouvasmes un païs qui n'est pas si montagneux, l'air y est bien plus doux, les campagnes sont belles, et les terres y produiroient beaucoup, et seroient capables de nourrir de grands peuples, si on les faisoit valoir. Ce païs, le plus beau de toute nostre route, a continué jusqu'à Némiskau, où nous arrivasmes le 25. Juin sur le midy.

"Némiskau est un grand Lac de dix journées de circuit, entouré de grandes montagnes, depuis le Sud jusqu'au Nord, formant un demy cercle; on voit à l'embouchure de la grande rivière, qui s'étend de l'Est au Nordest, des vastes plaines, qui regnent mesme au dessous des montagnes qui font le demy rond, et toutes ces campagnes sont entrecoupées si agréablement d'eau, qu'il semble à la veuë que ce soient autant de rivières, qui forment un aussi grand nombre d'Isles, qu'il est difficile de les pouvoir compter. On voit toutes ces Isles tellement marquées des pistes d'orignaux, de castors, de cerfs, de porc-épics, qu'il semble qu'elles soient le lieu de leur demeure, où ils font leurs courses ordinaires. Cinq grandes rivières se déchargent dans ce Lac, qui font que le poisson y est si abondant, qu'il faisoit autrefois la principale nourriture d'une grande nation sauvage qui l'habitoit il n'y a que huit ou dix ans...."

Plus loin il fait une description non moins avantageuse des environs de la baie James.

"Ceux-là se sont trompez, dit-il, qui ont crû que ce climat estoit inhabitable, soit à raison des grands froids, des glaces et des neiges, soit par le défaut de bois propre à bastir et à se chauffer. Ils n'ont pas veu ces vastes et épaisses forests, ces belles pleines et ces grandes prairies, qui bordent les rivières en divers endroits, couvertes de toute sorte d'herbage propre à nourrir du bétail; je puis assurer qu'au quinziesme de Juin, il y avoit des roses sauvages aussi belles et aussi odoriferantes qu'à Quebec, la saison mesme m'y paroissoit plus avancée, l'air fort doux et agreable. Il n'y avoit point de nuit, quand j'y estois, le crepuscule n'estoit point encore finy au couchant, quand l'aube du jour paroissoit au levant du Soleil."

Maintenant que le Canada, en devenant acquéreur par l'acte de cession de 1870 de tous les droits de la compagnie de la baie d'Hudson, a tranché les difficultés en litige qui ont pu exister jusque là, je me demande quelle raison valable le gouvernement fédéral pourrait opposer à la requête qui un jour ou l'autre lui sera adressée, demandant l'extension de notre frontière nord.

Nous, habitants de la province de Québec, ne ferons tort à personne en prenant notre part de ces vastes territoires que nos ancêtres ont arrosés du meilleur de leur sang.

X — *Epître à M. Prendergast, après avoir lu "Un soir d'automne,"* [1]

Par PIERRE J. O. CHAUVEAU.

(Lu le 30 mai 1885.)

Lorsque m'est parvenu votre charmant envoi,
J'étais encor malade et retenu chez moi.
On m'avait interdit écriture et lecture ;
Mais — vous le devinez car c'est dans la nature —
Par cet arrêt cruel vous n'avez rien perdu,
Et votre œuvre eut l'attrait de tout fruit défendu.

Vous êtes au printemps, et vous chantez l'automne !
Et moi, qui vois venir les plus sombres hivers,
Du caprice dictant le sujet de vos vers
Si tristes et si doux à bon droit je m'étonne !

Mais l'homme est ainsi fait : il aspire toujours
A de nouveaux bonheurs, et les veut à rebours
Du lieu, de la saison, de l'âge ou de l'année ;
La joie à peine éclose est bientôt dédaignée ;
Heureux à faire envie on cherche un autre sort ;
L'avenir a raison, le présent seul a tort.

Voilà comment se font tant d'étranges contrastes ;
Pourquoi l'on se surprend, aux jours les plus joyeux,
L'âme tout assombrie, et des pleurs dans les yeux ;
Pourquoi souvent on rit aux jours les plus néfastes ;
Pourquoi l'on voit partout pauvres en belle humeur,
Riches livrés en proie à l'amère douleur,
Jeunes gens tout rêveurs, pleins de mélancolie,
Vieillards qu'agite encor la joyeuse folie.

Vous n'êtes point, je sais, de ces pleureurs à froid
Qui se font un métier d'une peine factice,
Qui tremblent sans avoir au cœur le moindre effroi,
Taxant à tout propos le destin d'injustice.

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[1] Cette pièce fut écrite quelques semaines après le grave accident qui faillit coûter la vie à l'auteur, en 1881.

Vous avez du malheur ressenti l'aiguillon ;
Sur votre front si jeune où brille le génie
Déjà les lourds chagrins ont tracé leur sillon ;
Et la douleur en vous fit naître l'harmonie.

Mais qu'on aime à souffrir lorsqu'on souffre à son gré !
L'on formule soi-même un programme à sa peine :
La nature riante est pour nous trop sereine ;
Trop riche est à nos yeux le nuage empourpré ;
Dédaignant fièrement amour, printemps, jeunesse,
On cultive avec soin le doute et la tristesse ;
Et l'on va se drapant dans de sombres manteaux ;
Et l'on suit tout pensif le sentier des tombeaux.

Puis, quand de vrais malheurs ont ravagé notre âme,
Quand le funèbre glas ne cesse de sonner,
Quand nos derniers amis vont nous abandonner,
Quand notre esprit n'est plus qu'une tremblante flamme,
On se reprend à vivre, et, malgré les soucis,
Au temps impitoyable on demande un sursis :
Encore une saison, encore une récolte !
On voudrait rattraper printemps, jeunesse, amour !
Contre la vieille loi l'homme en vain se révolte :
Jeunesse, amour, printemps sont passés pour toujours.

Pour toujours ? oh ! non pas ; il est une autre vie
Où l'automne sévère au printemps se marie.
Là le bonheur est fait de nos chagrins passés ;
L'amour est infini, la jeunesse éternelle ;
Les doutes sont vaincus, les remords effacés ;
Sans nous enorgueillir notre gloire étincelle ;
Près du nôtre s'élève un trône plus brillant,
Sans nous humilier ; l'opprimé triomphant
Pardonne à l'oppresseur ; celui dont nos largesses
Soulageaient la misère est au sein des richesses ;
Et les riches cruels, qui n'eurent ici-bas
Tendresse ni pitié, sont ceux qu'on n'y voit pas.

Que sont, auprès du ciel, les spectacles terrestres,
Les vallons de la Grèce ou les scènes alpestres ?
Dans les bosquets divins aux rameaux élancés
S'avancent lentement les chastes fiancés.
Si la mort crut tromper leurs nobles espérances,
Ils en sont plus heureux, heureux de leurs souffrances ;
Tous les pleurs qu'ont versés ces fidèles amants,
Ils les retrouvent là, perles ou diamants.

Nous y verrons aussi meilleures et plus belles,
Epouses, filles, sœurs, et mille sœurs nouvelles,
Parmi les chérubins tous nos joyeux enfants,
Et nos bons vieux aïeux n'ayant plus que vingt ans.

Et nos pères diront, admirant leur ouvrage :
Dieu l'avait fait aimable, et moi je l'ai fait sage ;
Nos mères qui pour nous ont cessé de souffrir,
De souffrir dans ce monde et d'expier dans l'autre,
Qui, victimes toujours trop promptes à s'offrir,
Sur leur propre fardeau chargeant souvent le nôtre,
Le portèrent encore au-delà du tombeau,
L'épreuve étant finie, en leur sainte allégresse,
Nos mères trouveront le ciel encor plus beau,
Nous y voyant enfin rendus à leur tendresse.

Poète, dans vos vers vous rêviez ce bonheur,
Et ce rêve charmant, qui trompait la douleur
Eclose bien trop tôt dans votre âme candide,
Ce rêve est un rayon qui du ciel même vient.
On l'a dit avant nous : dans ce monde sordide,
L'homme est un dieu tombé, — toujours il s'en souvient.

Québec, mai 1881.

XI — *L'élément étranger aux Etats-Unis,*

Par FAUCHER DE SAINT-MAURICE.

(Lu le 27 mai 1885.)

Un écrivain américain, M. Joseph Edgar Chamberlin, vient de faire paraître une étude remarquable sur les éléments hétérogènes qui entrent dans la formation de la population des Etats-Unis.

Son travail est fait consciencieusement, sans phrases, sans commentaires superflus, et à ce titre il mérite l'attention de nos compatriotes, curieux de suivre les développements de nos voisins.

En étudiant le dernier recensement fait aux Etats-Unis, on constate qu'en 1880 il y avait 1,966,742 Allemands, ce qui est au total de la population 3·9 p. 100. A cette époque, il y avait 1,854,571 Irlandais, c'est-à-dire 3·7 par 100 sur le total de la population. En général, l'Allemand vient aux Etats-Unis pour fuir le militarisme. Le but de sa vie est d'avoir sa ferme, ses bestiaux à lui. Il se fait agriculteur pour devenir propriétaire. L'Irlandais traverse l'Atlantique et accourt aux Etats-Unis pour fuir le *landlordisme.* Il veut humer l'air de la liberté à l'ombre du drapeau étoilé. Une fois ce plaisir platonique passé, comme il est arrivé sans le sou, il s'en va traîner une existence peu enviable dans les mines ou dans les manufactures.

L'élément anglais, écossais et gallois entre dans le recensement de 1880 pour le chiffre de 917,578. La plupart de ces émigrés se dévouent au travail des mines. Les Anglais se massent maintenant dans l'Utah, où — qui le croirait! — ils sont attirés par les attraits du mormonisme. Dans cet Etat on compte aujourd'hui 25,258 Anglais.

L'Amérique du Nord, écrit M. Chamberlin, apporte elle aussi son fort contingent à l'accroissement de la population des Etats-Unis, contingent de 717,157 âmes. L'élément anglais du Canada s'assimile promptement aux Yankees, et entre immédiatement dans le mouvement national. *Il n'en est pas de même des Canadiens-français qui viennent chez nous. Ils sont difficiles à rallier. Ils ont l'esprit de clan, se tiennent ensemble, ne parlent que leur langue entre eux, se cramponnent à leurs coutumes, à leurs traditions, restent indifférents aux droits que leur confère le titre de citoyen des Etats-Unis, et sont pour la plupart imprégnés d'idées monarchiques.* Notre recensement ne donne pas d'une manière précise le nombre des Canadiens-français qui habitent maintenant les Etats-Unis, mais je ne crois pas me tromper en acceptant les statistiques canadiennes, et en le portant *au chiffre de* 275,000.

L'immigration qui vient du Canada aux Etats-Unis se distribue ainsi dans chaque Etat :

Michigan	148,866	Washington	2,857
Massachusetts	119,302	Montana	2,481
New-York	84,182	Texas	1,472
Maine	37,114	Kentucky	1,070
Illinois	34,048	Utah	1,338
Minnesota	29,631	Maryland	988
Wisconsin	28,965	Arkansas	787
New-Hampshire	27,142	Louisiane	726
Vermont	24,620	Virginie	585
Iowa	21,097	Idaho	584
Californie	18,889	Arisona	511
Rhode-Island	18,306	Tennessee	546
Connecticut	16,444	Wyoming	542
Ohio	16,146	District de Colombie	414
Kansas	12,536	Floride	443
Pennsylvanie	12.376	Caroline du Nord	425
Dakota	10,658	Géorgie	348
Missouri	8,685	Virginie Occidentale	295
Nebraska	8,622	Nouveau-Mexique	280
Colorado	5,785	Alabama	271
Indiana	5,569	Mississipi	231
New-Jersey	3,533	Delaware	246
Nevada	3,147	Caroline du Sud	141
Oregon	3,019		

Les Norvégiens, les Suédois et les Danois sont au nombre de 440,266. Pour sa part, le Minnesota en compte 108,768, le Wisconsin 66,284, et l'Illinois 65,414. Les trois quarts de ces émigrants habitent les Etats du Nord-Ouest. Partout où ils se groupent, ils conservent leur caractère national.

La France envoie peu d'émigrants aux Etats-Unis. Elle n'y compte que 106,971 des siens, répartis comme suit :

New-York	20,321	Californie	9,559
Ohio	10,136	Illinois	8,525
Lousiane	9,992	Pennsylvanie	7,049

D'après M. Chamberlin, il n'y a qu'en Louisiane et en Californie que l'élément français compte un par cent dans la population. Dans ces deux Etats, ils donnent la main aux émigrants du sud de l'Europe pour former un groupe latin important. *L'élément français et l'élément canadien-français, réunis ensemble, donnent à la race gallique un total de* 380,000 *âmes, chiffre qui n'est pas aussi considérable, il est vrai, que celui donné par le groupe scandinave, mais qui tout de même exerce sa prépondérance sur les trois Etats du nord de la Nouvelle-Angleterre.*"

Les Chinois sont au nombre de 104,469. Ils habitent surtout la Californie, l'Oregon, le Nebraska et l'Idaho. La Californie en compte 73,548 pour elle seule.

Après avoir résumé sérieusement l'étude de M. Chamberlin sur les éléments étrangers qui entrent dans la formation du peuple des Etats-Unis, il est curieux de suivre à travers tous ses chiffres et toutes ses déductions la marche de l'élément canadien-français.

"L'élément étranger, assure-t-il, prédomine surtout dans le Rhode-Island, où 24·4 p. 100 sont d'extraction étrangère, et 51·9 p. 100 sont alliés à des étrangers. 12·75 p. 100 de la population de l'île sont irlandais, et 28 p. 100 de descendance irlandaise, *tandis que les*

Canadiens-français y comptent pour 10 sur 100. Ces rejetons de la race celte et de la race gallique sont de fervents catholiques romains. Ils sont plus nombreux, pendant la présente génération du moins, que le total des vieilles familles du Rhode-Island, d'où il est aisé de conclure que cet Etat devient sûrement un des boulevards de la religion catholique romaine aux Etats-Unis... Ce sera le premier Etat qui donnera une majorité catholique.

" Le Massachusetts vient après le Rhode-Island. Là nous avons une population étrangère de 24·9 p. 100, et une population de descendance étrangère de 49·5 p. 100. Le nombre des Irlandais diminue comparé à la totalité de la population étrangère, *mais celui des Canadiens augmente.*

" Le Connecticut approche les chiffres des deux Etats précédents. Il a 21·0 p. 100 de population étrangère : 11·1 de cette population étant irlandais, 3·2 anglais et 2·5 canadiens.

" Dans le Maine, la population étrangère est de 9·1 p. 100, 5-7 p. 100 étant canadiens et 2 p. 100 irlandais. Dans le New-Hampshire 13·4 p. 100 sont des étrangers, 7·7 p. 100 *étant des Canadiens-français,* et 3·7 p. 100 des Irlandais. Au Vermont 12·4 p. 100 sont étrangers, 7·1 p. 100 *étant des Canadiens,* et 3·5 p. 100 des Irlandais. Le Maine, le Vermont, le New-Hampshire se ressentent peu de la présence de ces éléments hétérogènes, car *la majorité de la population de ces Etats étant canadienne-française se déplace continuellement. Néanmoins ces Canadiens resteront eux-mêmes beaucoup plus longtemps que les autres étrangers qui vivent à côté d'eux, car ils sont en constante communication avec leur patrie, le Canada français.*

" La Louisiane contient 5·8 p. 100 de population étrangère, répartie comme suit : 1·8 p. 100 d'Allemands, 1·4 p. 100 d'Irlandais, et 1 p. 100 de Français.

" Dans cet Etat on trouve néanmoins qu'il y a 15·5 p. 100 de la population qui sont étrangers, preuve que l'immigration n'a pas été aussi considérable depuis quelques années que dès les commencements de la Louisiane. Ici, une chose frappe l'observateur. Il se trouve en présence d'une population ancienne, dévouée aux Etats-Unis dans le sens politique du mot, mais qui parle une langue étrangère à son pays. Les Créoles de la Louisiane ne se prêtent pas encore à nos manières ; il est difficile de pénétrer dans leur intimité, mais néanmoins ils n'ont pas de chauvinisme de race, et ils ne font rien sous ce rapport qui ne soit consistant avec leur titre de citoyen américain. *Ils forment ainsi contraste avec les descendants des colons français du Canada, qui sont encore si vivement attachés à la France, bien qu'ils en aient été séparés bien des générations avant que la Louisiane ait cessé à son tour d'être française.* Ne serait-il pas logique de conclure de cette différence que les institutions républicaines ont plus le pouvoir d'assimiler les peuples que les institutions monarchiques ? Les Créoles de la Louisiane peuvent être comparés à ces descendants des colons allemands, en Pennsylvanie. Ils parlent encore la langue de leurs pères, mais ils ne songent guère à d'autre nationalité qu'à la nationalité américaine.

" L'élément étranger est puissant au Michigan. Il y compte pour 24·8 p. 100. *Les Anglais mêmes du Haut-Canada y sont en majorité. Ils forment* 9.0 *p.* 100 *de la population totale.* Dans le territoire du Dakota, les étrangers comptent 38·4 p. 100 de la population. *Sur ce chiffre* 7.1 *p.* 100 *sont des Anglais d'Ontario qui, mécontents du Manitoba, viennent s'établir ici.*"

Les conclusions de M. Chamberlin sont celles-ci :

Parmi les citoyens qui forment la population des Etats-Unis, les Allemands sont en majorité dans les Etats et territoires suivants : Alabama, Arkansas, Illinois, Indiana, Iowa,

Kansas, Kentucky, Louisiane, Maryland, Missouri, Nebraska, Ohio, Caroline du Sud, Virginie Occidentale et Wisconsin.

Les Irlandais ont la majorité dans douze Etats : Connecticut, Delaware, District de Colombie, Géorgie, Massachusetts, Mississipi, New-Jersey, New-York, Pennsylvanie, Rhode-Island, Tennessee et Virginie.

Les Chinois ont formé noyau dans cinq Etats et territoires : Californie, Idaho, Nevada, Oregon et Washington.

Les Canadiens-français commandent la majorité étrangère dans le Maine, dans le New-Hampshire et dans le Vermont ; les Anglais du Haut-Canada, au Michigan et dans le Montana ; les Anglais, dans la Caroline du Nord, le Colorado, l'Utah et le Wyoming ; les Mexicains, dans l'Arizona, le Nouveau-Mexique et le Texas ; la race Scandinave, dans le Dakota et le Minnesota ; les émigrants des Indes occidentales, dans la Floride.

En terminant son intéressant travail, M. Chamberlin jette un regard sur la carte des Etats-Unis, et nous prie de nous rendre compte de la position prise par ces divers groupes étrangers.

" Ce que nous nommerons les Etats irlandais, dit-il, commence au Massachusetts et se déroule tout d'une pièce au sud jusqu'au Maryland. Ils reprennent leur course en Virginie, inclinent vers l'ouest, passent par le Tennessee et viennent aboutir au golfe par la Géorgie et le Mississipi. Les Etats allemands forment au centre de la république un groupe compact. Ils vont du lac Supérieur au golfe du Mexique, c'est-à-dire du Wisconsin à la Louisiane, et à l'est ils partent du Nebraska, poussent une pointe à travers la Virginie Occidentale et le Maryland jusqu'à l'Atlantique. *Les Canadiens-français ont un groupe dans le nord de la Nouvelle-Angleterre, et les Anglais d'Ontario un autre dans le Nord-Ouest, au Michigan et dans le Montana,* ces deux groupes étant protégés *par la frontière canadienne.* Les Anglais ont trois divisions politiques qui se touchent, et un Etat détaché dans le sud des Etats-Unis. Les Mexicains ont les Etats limitrophes à leur pays, et les Chinois ceux qui regardent la Chine."

Voilà en peu de mots l'analyse de l'étude élaborée que M. Chamberlin vient de faire sur le dernier recensement des Etats-Unis.

Elle est curieuse sous plus d'un point, et elle apporte un argument de plus à ceux qui croient que les Canadiens-français sont tôt ou tard appelés à de hautes destinées.

M. Rameau disait que les Canadiens allaient franciser la Nouvelle-Angleterre. Ce rêve peut se réaliser avant un siècle, dit le *Travailleur*, journal français publié aux Etats-Unis, si nos enfants demeurent Canadiens-français comme le sont leurs pères. Pour cela il faut l'école, encore l'école : il faut des professeurs patriotes, des instituteurs patriotes et tous les efforts d'un clergé patriote. Pour cela il faut des associations nationales qui soient fières d'elles-mêmes, et qui inculquent à leurs membres la fierté nationale. Avec tous ces éléments nous imposerons notre nationalité dans certaines parties des Etats-Unis, mais pas autrement.

N'est-ce pas la nationalité canadienne-française qui, en jetant son veto dans la balance politique, a porté aux honneurs de la présidence le chef actuel des Etats-Unis, M. Cleveland ?

En 1760 les Canadiens-français étaient 60,000. Aujourd'hui ils sont 1,073,820 au Canada, 102,743 dans Ontario, et, d'après les calculs de M. Chamberlin, 275,000 aux Etats-Unis.

Les provinces maritimes comptent 108,605 Acadiens, qui sont pour nous les frères des mauvais jours comme des jours ensoleillés.

Avec du courage, de la persévérance, de l'union, du travail et par-dessus tout un dévouement incessant à notre religion et à notre laugue, l'avenir ne peut faire autrement que d'être à nous tous. Tôt ou tard, en marchant ensemble, nous arriverons à être une grande nation. La conclusion logique de ce travail ne peut être autre que celle-ci :— Un jour nous serons la France catholique américaine.

XII — *Autrefois et Maintenant,*

Par NAPOLÉON LEGENDRE.

(Lu le 27 mai 1885.)

J'ai souvent entendu les vieux
Dire que ça ne va plus guère,
Que de leur temps tout était mieux,
Et que le monde dégénère.

Je vous vois de suite invoquer
Le droit de lever les épaules,
Et tout doucement vous moquer
De ces singulières paroles.

Un instant. Comparons un peu
Quelque chose de chaque époque ;
Après cela vous aurez lieu
De juger s'il faut qu'on se moque.

Dans l'ancien temps, — et vous devez
En avoir gardé souvenance,
Puisque comme moi vous avez
Pour le moins quarante ans, je pense, —

Au jour de l'an, chacun faisait
Trève à toute amère pensée ;
La vieille haine se taisait :
C'était une page effacée.

Bien mieux que le plus beau sermon,
L'époque des fêtes joyeuses
Savait ramener la raison
Dans les âmes trop rancuneuses.

De grand matin on s'en allait
Au foyer de chaque famille ;
Partout — chose aisée — il fallait
Embrasser la mère et la fille,

Serrer la main du père, et puis
Donner au bébé quelque chose :
Point d'or ni d'argent, quelques fruits
Conservés dans la cave close ;

Ou bien des jouets peu coûteux,
Ne cassant pas quand on les touche ;
Ou du sucre — sans goût pâteux.
— L'eau m'en vient encore à la bouche !

On jasait, et l'on se disait,
Sans arrondir de période,
Exactement ce qu'on pensait :
Tenez, c'était bien plus commode.

Quand on était prêt à partir,
Il fallait, car c'était l'usage,
Accepter avant de sortir
Un doigt de rhum, pas davantage.

C'était une bonne boisson
Venant tout droit de Jamaïque ;
On la gardait à la maison
Pour cette occasion unique.

Et partout, le long du chemin,
Toujours quelque figure amie,
Braves gens, le cœur sur la main,
Et plein l'âme de bonhomie !

— Et voilà comment, autrefois,
On vivait, un peu terre à terre ;
Et plus j'y pense et plus je crois
Que c'était la bonne manière.

Aujourd'hui tel n'est plus le cas ;
On prétend faire mieux les choses :
Les bouches parlent, mais, hélas !
Les âmes souvent restent closes.

Le jour de l'an n'est plus pour nous
Qu'une interminable corvée,
Et les plus patients ont tous
Hâte de la voir achevée.

On se fait encor des souhaits
En très grande cérémonie ;
On donne aux enfants des jouets
Importés de la Germanie ;

On vous offre aussi des liqueurs
Aux essences délicieuses,
Qui semblent réchauffer les cœurs
Et rendre les phrases moins creuses ;

Eh bien, c'est moi qui vous le dis :
Souhaits, jouets, phrases ouatées,
Douces liqueurs, sucres candis,
Ce sont des choses frelatées !

Donc, je conclus avec les vieux
Qu'aujourd'hui ça ne va plus guère,
Que de leur temps tout était mieux,
Et que le monde dégénère.

XIII — *L'anatomie des mots*, [1]

Par NAPOLÉON LEGENDRE.

(Lu le 27 mai 1885.)

On dit que les trésors des connaissances humaines sont accumulés et conservés dans les livres et dans les œuvres de l'art. Cela est vrai. Mais, d'un autre côté, que de richesses sont contenues dans les simples mots dont nous nous servons tous les jours, sans nous douter souvent des choses intéressantes, des beautés même qu'ils renferment. Nous sommes à cet égard comme un voyageur qui parcourt des plaines où gisent les débris d'anciennes cités dont il ne connaît pas, ou dont il ne connaît qu'imparfaitement l'histoire. Il voit çà et là des tronçons de colonne, des fragments de muraille, qui ne provoquent dans son esprit que des idées conformes aux images qu'il a sous les yeux. Que serait-ce, s'il pouvait rétablir ces colonnes, relever ces murs, reconstruire, en un mot, l'ancienne ville détruite ! Chaque muraille, chaque monument, chaque pierre lui révèlerait soudain tout un passé qui dort ; il pourrait y voir revivre toute une nation, y lire page par page l'histoire de toute une époque.

Quelqu'un a dit que l'ignorance est la mère de l'admiration. Voilà une bien fausse assertion. Pour une fois que l'ignorance nous fait admirer des choses qui ne sont pas dignes de l'être, cent fois elle nous empêche d'apprécier à leur valeur des objets ou des faits qu'une connaissance plus approfondie nous révèlerait sous leur jour véritable et dans toute leur sublime grandeur. Cependant l'esprit humain est ainsi fait — ou plutôt la routine le façonne de telle manière — qu'il accepte tout de bonne foi et se contente de juger les choses à leur surface ou d'après les notions les plus répandues. Ainsi, que de gens ont appris à admirer et admirent encore cette maxime de Boileau :

> Ce que l'on conçoit bien s'énonce clairement,
> Et les mots pour le dire arrivent aisément !

Eh bien, franchement, il n'y a là qu'une apparence de sagesse. Tous ceux qui ont pensé un peu, tous ceux qui parlent ou qui écrivent pour le public savent parfaitement qu'il existe une vaste différence entre la conception claire d'un objet, d'un sentiment, et sa description en termes précis et appropriés. Ainsi, pour me servir du premier exemple qui se présente à mon esprit, nous concevons parfaitement ce que c'est que le passé, le présent et le futur. Or combien y en a-t-il parmi nous qui, avec cette claire conception dans l'esprit, soient prêts à donner sur le champ, et même en y réfléchissant, une explication également claire de ces trois termes si simples en apparence et si faciles

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[1] J'ai puisé de nombreux renseignements, pour cette étude, dans un travail du T. R. Richard Chenevix Trench, archevêque de Dublin, dans l'*Essai d'étymologie philosophique* de l'abbé Chavée, et dans une conférence de M. Michel Bréal, publiée dans la *Revue politique et littéraire*.

à concevoir ? Et que serait-ce donc si nous abordions le domaine des sentiments et des sensations ! Interrogez les auteurs didactiques, les lexicographes, par exemple, qui sont obligés de définir chaque mot qu'ils inscrivent dans leurs dictionnaires. Vous verrez ce qu'ils pensent de la profonde maxime de Boileau. Cette fois, c'est bien véritablement l'ignorance, ou l'absence de réflexion qui est la mère de l'admiration.

Mais, en général, c'est le contraire qui arrive. On passe à côté des choses les plus intéressantes, les plus dignes d'être admirées, et l'on n'y porte qu'une attention distraite. Ah ! si l'on savait quelles richesses on coudoie, quels trésors on foule ainsi sans s'en douter !

Et c'est bien surtout lorsqu'il s'agit des mots qui composent le langage que cette vérité s'affirme.

Nous nous habituons à parler sans nous rendre compte exactement des expressions dont nous nous servons. Et cela est tellement vrai que, par la force de l'habitude, les mots se présentent à la mémoire sans aucun effort, et sans que nous soyons obligés de recourir à ce travail que fait celui qui cherche un terme quelconque dans un dictionnaire. Car notre mémoire est un véritable dictionnaire qui contient non seulement tous les mots que nous avons entendus, mais encore toutes les acceptions différentes dans lesquelles ces mots sont arrivés à notre oreille. Et cependant, lorsque nous demandons à notre mémoire un terme dont nous avons besoin, ce terme se présente aussitôt, non pas avec toutes ses acceptions, comme dans le vocabulaire, mais avec la seule signification qui soit conforme à l'idée que nous voulons exprimer. Ainsi, lorsque je dis : "J'ai lu un livre," le mot *livre* s'offre tout de suite à mon esprit, et à l'esprit de celui qui m'écoute, dans l'acception "d'ouvrage écrit ou imprimé, composé de feuilles, de pages et de lignes." Ma mémoire ne me donne pas le mot *livre* dans le sens de "poids contenant un certain nombre d'onces," ni dans le sens de "monnaie ayant cours dans certains pays." Ces deux autres acceptions restent cachées pour ne laisser surgir que celle dont j'ai besoin. Ce n'est pas ici le lieu d'expliquer comment se fait cette mystérieuse opération qui naît d'une longue pratique, et qui ressemble un peu au travail que fait l'organiste en touchant chaque note de son accord, et l'imprimeur en cueillant pour ainsi dire chaque lettre de sa casse. Il suffit de constater le fait pour montrer comment l'esprit s'habitue à employer un mot dans son acception la plus générale, sans se donner la peine de réfléchir sur les significations additionnelles que ce mot peut contenir et sur le chemin qu'il a pu parcourir, les transformations qu'il a pu subir, avant d'arriver à représenter l'idée qui s'y rattache.

Et cependant que de choses il y a souvent dans un seul mot, dans une seule syllabe ! Emerson dit quelque part que le langage est une *poésie fossile.* C'est la vérité ; mais ce n'est pas toute la vérité. La langue n'est pas seulement une poésie fossile, c'est encore toute une mine d'histoire, de morale et de religion. C'est, en un mot, la photographie d'un peuple ; mais une de ces photographies qu'on ne peut saisir et apprécier qu'à l'aide d'une loupe puissante ; et cette loupe, ce verre grossissant, c'est l'analyse, c'est l'anatomie des mots.

"Dans le vocabulaire d'une langue, dit Ozanam, on a tout le spectacle d'une civilisation. On y voit ce qu'un peuple sait deschoses invisibles... On mesure la puissance de ses institutions par le nombre et la propriété des termes qu'elles veulent pour leur service ; la liturgie a ses paroles sacramentelles, la procédure a ses formules. Enfin, si ce peuple a étudié la nature, il faut voir à quel point il en a pénétré les secrets, par quelle variété d'expressions, par quels sons flatteurs ou énergiques il a cherché à décrire les divers aspects du ciel et de la terre, à faire pour ainsi dire l'inventaire des richesses dont il dispose."

Je n'ai pas l'intention, dans ce court travail, d'embrasser en son entier un aussi vaste sujet. Je veux me borner, en étudiant un certain nombre d'expressions prises un peu au hasard, à montrer quelle abondante moisson on pourrait recueillir en cultivant davantage un champ si riche et si facile à exploiter.

Coleridge dit : " In order to get the full sense of a word, we should first present to our minds the visual image that forms its primary meaning." C'est-à-dire, pour obtenir le sens complet d'un mot, il faut d'abord présenter à notre idée l'image matérielle qu'offre son sens primitif. En d'autres termes, pour bien comprendre une expression, il faut remonter à son radical ou à sa racine, et c'est ce que nous allons faire.

Prenons d'abord les expressions qui contiennent, comme le dit Emerson, une " poésie fossile."

Vous dites souvent d'une personne qu'elle est *sincère*, et vous savez parfaitement ce que vous voulez dire et ce que vous dites ; mais vous ne songez peut-être point à l'origine de cette simple expression. Le dictionnaire nous donne pour étymologie les deux mots latins *sine cera*, sans cire ; c'est-à-dire un objet qui se présente à découvert, non fardé, non enduit de cire. Il y a quelque raison dans cette étymologie, mais j'avoue qu'elle ne me satisfait qu'à demi. J'aime mieux faire remonter *sincère* à deux mots grecs : *sun*, avec, et *keir*, la main. La sincérité est donc assimilée à un objet qu'on tient à la main, qu'on expose à tous les regards, et qui par conséquent ne cache rien. Nous avons du reste une expression bien ordinaire qui semble confirmer cette étymologie. Ne disons-nous pas en effet tous les jours : cette personne est généreuse, franche, elle a " le cœur sur la main ? " Il y a là une ressemblance trop grande pour qu'elle soit accidentelle. Quant au changement du *ki* grec en *c* doux, il n'offre aucune difficulté et se rencontre très souvent. Ainsi *archevêque* et *archiépiscopal*, qui viennent tous deux de *arkein*, donnent les deux transformations.

Le mot *capricieux* offre encore une image assez poétique. Il vient en droite ligne de *capra*, chèvre. L'homme capricieux est celui dont l'esprit ne sait pas se poser et passe continuellement d'une idée, d'un objet à un autre, de même que la chèvre saute de rocher en rocher. L'anglais *desultory* qui signifie inconstant, irrégulier, a une origine presque semblable, puisqu'il vient de *saltare* qui veut dire sauter, danser.

Tout le monde connaît l'*écureuil*, ce petit quadrupède si joli, si vif, si léger ; mais tout le monde ne sait pas quelle poétique image offre son nom lorsqu'on le décompose. Ecureuil vient du latin *sciuriolus*, tiré du grec *skiouros*, que l'Anglais reproduit mieux que nous dans *squirrel ; skiouros* est formé lui-même des deux substantifs *skia*, ombre, et *oura*, queue ; c'est donc l'animal qui se fait de l'ombre avec sa queue. Si nous étions encore au temps où les animaux parlaient, je suis certain que l'écureuil dirait qu'il se reconnaît parfaitement dans cette description.

Ceux qui ont lu les œuvres de Shakspeare — et c'est tout l'univers civilisé — ont sans doute admiré ce génie étonnant. Mais le nom lui-même a quelque chose de très remarquable. Shakspeare signifie : l'homme qui brandit une lance. Comme le dit Ben Johnson en parlant des vers du poète :

> In each of which he seems to shake a lance
> As brandished in the eyes of ignorance.

Traduction :

> Dans chacun de ses vers il brandit une lance
> Qui brille, redoutable, aux yeux de l'ignorance.

Celui qui s'est servi la première fois du mot *dilapider* a dû voir surgir dans son esprit l'image d'un édifice dont les murailles se désagrègent, et qui tombe pierre par pierre. Ainsi, un homme qui dilapide sa fortune fait comme celui qui abat sa maison ou la maison de son voisin, non pas tout d'un bloc avec une cartouche de dynamite, suivant la mode du jour, mais lentement et morceau par morceau.

Quand nous parlons des *tribulations* qui nous assiègent, nous pouvons, non pas nous consoler, mais du moins opérer une certaine diversion en songeant que ce mot vient du latin *tribulum* ou *tribula*, et du grec *tribolos*, qui désignent une espèce de herse et un instrument pour égrener le blé. L'homme en proie aux tribulations est comme le grain secoué par le *tribulum*, ou comme le sol déchiré par la herse ; les deux alternatives sont loin d'être agréables, mais la poésie ne vit pas toujours sur les fleurs. Des fleurs au papillon, la transition est assez naturelle. Le mot *papillon* n'offre pas en français une image très poétique ; il est formé d'un redoublement de la racine sanscrite *pil*, qui signifie vaciller, onduler. Mais son nom espagnol *mariposa, mar-i-posa*, mer et repos, est très caractéristique. C'est l'insecte agité comme la mer à un certain moment, puis, l'instant d'après, calme, posé, comme la mer encore, quand les vents ne l'agitent plus. Et, à propos de la mer, les italiens ont une façon fort originale d'en peindre les vagues. Quand ces vagues sont légères, ils les désignent sous le nom de *pecore*, moutons ; si elles sont plus fortes, on dit que ce sont des *cavalloni*, c'est-à-dire de grands chevaux. Nous avons du reste en français la première de ces expressions ; nous appelons les petites vagues écumantes qui se brisent des *moutons ;* et nous disons des eaux qu'elles *moutonnent.*

Quand nous parlons du cristal, c'est encore une expression que nous empruntons à l'apparence de l'eau congelée. *Cristal* vient en effet de *kruos*, froid, et de *sthellesthaï*, être arrêté, figé. Le cristal est donc comme l'eau arrêtée, solidifiée par le froid. *Cru*, *crudité*, *cruel*, *cruauté*, viennent également de *kruos.*

Le mot *exiler* n'avait pas autrefois la signification qu'il a aujourd'hui. L'ancienne forme *essiler* signifiait maltraiter, rendre malheureux. De ce que le bannissement doit rendre malheureux et est même considéré comme le plus grand des malheurs, on a donné au verbe *exiler* le sens de bannir. Dans la langue allemande, le contraire précisément est arrivé : le mot *elend* a d'abord signifié exil, et aujourd'hui il signifie malheur, infortune.

Le mot *charme*, avant d'être pris dans son acception actuelle, désignait la poésie, le chant. Il vient du latin *carmen ;* et, de ce que la poésie enchante, captive, séduit, on a transformé son nom pour en faire le symbole d'un des plus aimables attributs de la compagne de l'homme. On retrouve encore la première physionomie de ce mot dans les incantations des sorciers et des sorcières qui produisaient des *charmes.*

Autrefois celui qui aspirait à une dignité s'appelait *candidat*, parce qu'il portait une robe blanche pour indiquer qu'il était, sinon sans reproche, au moins rempli de bonnes dispositions. Il faut avouer que, de nos jours, la tunique blanche n'irait pas à tous les candidats.

Les grecs et les latins donnaient le nom de *dactyle* à une certaine division des vers composée d'une longue et de deux brèves. Dactyle vient de *daktylos*, qui en grec veut dire doigt ; le doigt est composé de trois phalanges dont une longue et deux autres plus courtes, chacune de la moitié de la première. C'est là une jolie image ; seulement je comprends moins comment ce dactyle, qui signifie doigt, en est venu à former ce qu'on appelle, en versification, un *pied.*

Le rossignol tire son nom du mot latin *luscinia*, ou plutôt de son diminutif *lusciniola* ; c'est-à-dire l'oiseau qui chante dans les bosquets, ou l'oiseau qui chante sans y voir, après la tombée du jour. Dans ce dernier cas, le mot anglais *nightingale* aurait à peu près la même acception.

Parmi les mots qui offrent des images poétiques, nous pouvons encore citer *escarboucle*, qui signifie charbon incandescent ; *ramage*, chant des oiseaux, qui se répand, qui s'éparpille dans les rameaux des arbres ; se *pavaner*, c'est-à-dire marcher d'une manière superbe et prétentieuse, comme un paon qui fait la roue ; *Florence*, la cité des fleurs, comme le dit le poète :

> Poichè era posta in un prato de fiori,
> La dennero il nome bello onde s'ingloria.

Et, parmi les noms propres, nous avons *Esther*, l'étoile ; *Suzanne*, le lis ; *Marguerite*, la perle, et tant d'autres noms dont vous connaissez du reste aussi bien que moi la signification.

La médecine possède un grand nombre de mots qui offrent des racines intéressantes, mais peu poétiques. Cependant, voici une maladie qui porte un nom tout à fait imagé, c'est l'asthme. En effet, en langue sanscrite, le mot *as* veut dire lancer, souffler, et le mot *mu* ou *mur* signifie enclore, arrêter, faire obstacle. L'as(th)me est donc une respiration gênée, entravée, et le peuple n'a pas tort quand il donne à cette maladie le nom de "courte haleine" *kert*, couper, retrancher ; et *al*, s'élever, monter. [1]

Je pourrais multiplier ces citations, mais cela nous entraînerait trop loin. Je passe donc de suite aux expressions qui présentent dans leurs racines des idées de morale et de religion, et le mot *religion* lui-même me servira d'entrée en matière. En effet ce mot est formé des deux termes latins *re* et *ligare*, c'est-à-dire lier de nouveau, lier plus fortement. La religion est donc ce lien supérieur, surnaturel, qui non seulement unit les fidèles entre eux comme les membres d'une grande famille, mais qui les rattache à la Divinité.

Et les mots *morale, mœurs*, ne vienne-ils pas du latin *morari*, qui veut dire s'arrêter, être fixé ? On a donc appliqué cette idée de stabilité, de fixité, à l'état du bien, à l'existence réglée, parce que l'état du mal, l'existence déréglée sont censés n'avoir aucune permanence ; on doit faire des efforts constants pour en sortir. C'est encore des racines sanscrites *mu* et *mur* qu'est derivé ce mot *morari*, de même que *demeure, demeurer, morose* (qui reste fixé à une seule idée), et probablement les mots *mort* et *mourir*, qui indiquent l'obstacle, le point d'arrêt, la fixité par excellence. Quand on dit d'une personne qu'elle est passionnée, qu'elle agit avec passion, on se forme immédiatement une idée de force, de caractère impulsif, d'élans généreux. Eh bien, c'est tout le contraire qu'il faut croire, parceque c'est tout le contraire qui est vrai. *Passion*, vient du verbe latin *patior*, je souffre, je subis, je suis passif. Or l'homme qui agit par passion, par emportement, n'a pas de force ; au contraire il est faible et il fait preuve de faiblesse, puisqu'il se laisse conduire, gouverner par la circonstance, au lieu de la dominer. Il peut cependant produire un certain effet, mais ce n'est pas sa propre force qui produit cet effet, c'est simplement l'impulsion acquise. La même chose arrive quand vous perforez une planche avec une balle de liège lancée par le

[1] Les avocats et les notaires mêmes ne manquent pas de termes qui offrent une couleur poétique. Ainsi, le mot *stellionat*, qui désigne l'acte de vendre ou d'hypothéquer un immeuble dont on sait n'être pas le propriétaire, vient de *stellion*, espèce de lézard qui change de couleur et trompe l'œil.

canon d'un fusil. La balle de liège aurait bien mauvaise grâce à se vanter du résultat. On comprendra sans peine que je ne parle ici de la passion que dans un sens restreint, et que je n'entends pas désigner ces nobles élans de l'âme qui sont comme les explosions du génie, et qui produisent les grandes œuvres.

Quand on dénigre quelqu'un, on ne se figure pas toujours qu'on le noircit, qu'on en fait un nègre au moral, et pourtant c'est bien cela. *Dénigrer* vient tout droit de *niger* qui veut dire noir. Et quand on dit "qu'à blanchir un nègre on perd son savon," on ne se doute pas qu'on touche de près à un point de morale qui est celui-ci : quand, par la calomnie, on a détruit la bonne réputation d'une personne, il est presque impossible de la rétablir.

Voici encore le mot *humanités*, qui indique non seulement l'enseignement des belles-lettres, mais le développement de toutes les facultés humaines, l'éducation intellectuelle, morale et esthétique, qui fait de chacun de nous un homme dans la plus belle acception du mot. Et cependant combien de personnes prononcent ce mot tous les jours, sans songer à tout ce qu'il contient !

Les mots *duplicité* et *simplicité* sont deux termes bien ordinaires ; pourtant ils offrent deux images qui méritent d'être étudiées. La duplicité est l'état d'une personne qui est double, qui se présente sous plusieurs aspects, ou bien qui est repliée sur elle-même et ne laisse pas voir ses véritables sentiments. La simplicité, au contraire, n'offre rien de caché ; tout apparaît à la surface, comme sur une feuille non pliée. L'homme simple est sincère et franc.

Et ce mot *franc*, d'où vient-il encore ? C'est le nom d'un peuple, nom qui sert à personnifier la liberté, la droiture et l'honneur. De là viennent *franchise*. *affranchir*, *affranchissement*, *France* et *Français*. C'est la seule nation dans l'histoire qui ait mérité de donner son nom à une qualité morale, à une vertu. Tâchons de ne pas l'oublier.

Je n'irai pas plus loin en morale et en religion ; c'est un sujet qui n'est pas de ma compétence, je l'avoue humblement. Je pourrais m'exposer, avec la meilleure volonté du monde et sans m'en apercevoir, à tomber dans quelques-unes de ces grandes erreurs que certains esprits plus éclairés, plus subtils que le commun des mortels, ont découvertes de nos jours chez leur prochain. Le péril est grave, je m'y dérobe par la fuite.

Je pourrais cependant remarquer en passant, et à propos du mot *vertu* qui vient de tomber de ma plume, que l'étymologie que l'on donne ordinairement de ce mot n'est pas la véritable. On fait dériver ce mot de *vir* qui signifie, en français, homme, force, vigueur, verdeur ; mais il paraît venir en ligne beaucoup plus directe du sanscrit ou de l'indien *wertis*, excellence, mérite, du verbe *wer*, aimer, préférer : comparez l'anglais *worth*, qui a la même signification et la même origine.

Je donnerai, un peu plus loin, un certain nombre de mots dérivés de l'indien ou sanscrit. Car, dans bien des cas, les racines que nous tirons du grec apparaissent beaucoup plus clairement encore dans la langue indienne. Le grec s'est-il formé sur le sanscrit, ou bien les deux langues tirent-elles leur origine d'un langage primitif commun ? c'est ce qu'il est difficile d'établir. Quoi qu'il en soit, presque toutes les racines grecques se trouvent décomposées dans le sanscrit.

L'arabe nous a également fourni un certain nombre de mots. J'en donnerai quelques-uns plus loin.

Il est bien entendu qu'en citant ces exemples je n'ai pas l'intention d'attribuer à la langue française en général une origine arabe ou hindoue. Il est hors de doute que le

français proprement dit vient directement du latin : la langue populaire du bas latin, et la langue savante du latin classique. Un certain nombre de termes spéciaux sont tirés du grec.

On reconnaît la langue populaire en ce qu'elle respecte toujours l'accent latin, tandis que la langue savante en tient rarement compte.

En voici quelques exemples :

Latin :	Français pop :	Français sav :
Fragilis,	Frêle	Fragile,
Computum ou comptum,	Compte,	Comput,
Alumine	Alum,	Alumine,
Debitum,	Dette,	Débit,
Examen,	Essaim,	Examen,
Mobilis,	Meuble,	Mobile,
Organum,	Orgue,	Organe,
Porticus,	Porche,	Portique,
Polypus,	Poulpe,	Polype, etc.

Rien toutefois ne nous empêche, n'est-ce pas, de remonter un peu plus haut, en passant par le latin ou le grec, et d'aller quelquefois retrouver dans le sanscrit les premiers éléments des mots que nous étudions. Il ne faudrait pas cependant suivre le chemin que Ménage indique à propos du mot *haricot* qu'il tire de *faba* (fève). On a dû dire, écrit-il, *faba*, puis *fabaricus*, puis *fabaricotus*, puis *abricotus* et enfin *haricot*.

Je reviens pour un moment au mot *vertu*, par suite d'une réflexion qui m'a frappé, et qui ne manquera pas de vous frapper à votre tour. N'est-il pas singulier qu'on dise d'une femme qui tombe " qu'elle n'a pas su conserver sa vertu," tandis que d'un homme, on dit " qu'il n'a pas su conserver son honneur ? " Le mot *vertu* serait-il considéré comme se rapportant davantage à la femme, qui doit faire briller, surtout au foyer domestique, les qualités solides du cœur et de l'esprit, le renoncement de soi-même, le mérite caché et ignoré, le dévouement par excellence ? Et le mot *honneur*, un peu plus retentissant, conviendrait-il mieux pour exprimer les qualités moins domestiques, plus extérieures de l'homme, qui est appelé surtout à l'existence du dehors, aux rapports sociaux ? C'est ce que je ne saurais décider. Il est singulier toutefois de constater combien souvent il arrive qu'on se serve d'expressions différentes pour peindre des états analogues chez l'homme et chez la femme, et comment aussi, pour l'une et pour l'autre, les mêmes mots n'ont plus la même signification. Ainsi, le plus souvent, un *grand homme* veut dire un homme d'un mérite considérable, tandis qu'*une grande femme* signifie plutôt une femme d'une taille élevée. Par contre, un *grand monsieur* est un homme de haute stature, et une *grande dame* est une femme distinguée par ses qualités, ses titres ou sa position.

Venons-en maintenant à l'histoire et à la géographie. J'ai déjà cité le mot *franc*, qui pourrait trouver ici sa place. Je pourrais également parler des appellations de grec, de juif et d'esclave (slave) qui offrent aussi un grand intérêt historique, dans un autre sens, mais sur lesquels il vaut mieux glisser sans appuyer davantage. Prenons des mots moins dangereux.

Tout le monde a mangé des *cerises*, mais tout le monde ne connaît pas l'origine de ce mot. Il vient de *Cérasonte* ou *Cérasus* (aujourd'hui Kérésoum), ville de l'Asie-Mineure, d'où Lucullus rapporta à Rome les premières cerises. Tous les fumeurs et les priseurs ne

savent pas, non plus, que l'appellatif *tabac* n'est pas le véritable nom de cette plante aromatique. Les naturels de l'île de San-Salvador, à l'époque des voyages de Colomb, appelaient cette plante *cohibar.* Ils la faisaient brûler sur un tison et en aspiraient la fumée; et c'est le tison lui-même qui s'appelait *tabaco,* nom qui a seul survécu.

Dans toutes les églises vous voyez une petite boîte qui porte l'incription : *Tronc pour les pauvres.* Pour comprendre ce mot, il faut se rappeler qu'autrefois on déposait les offrandes dans le creux d'un tronc d'arbre, sur la place publique. L'objet a changé de forme et de lieu, mais le nom est resté le même.

Le mot *mousseline* vient de Mosul, ville des bords du Tigre, où l'on fabriqua d'abord ce tissu. *Baïonnette* vient de Bayonne, où cette arme se fabriquait. *Baldaquin* tire son nom de Baldaco (corruption de *Bagdad*) où l'on tissait les étoffes avec lesquelles on fait les rideaux du baldaquin. Le *damas* se fabriquait surtout dans la ville de Damas, en Syrie, et la ville a légué son nom à l'étoffe. La *bougie* qui nous éclaire a emprunté son nom à la ville africaine de Bougie (en arabe Budjaïa), qui fournissait une grande quantité de cire, et où l'on fabriquait des bougies. De même *calico* vient de *Calicut,* ville de la côte du Malabar; *faïence,* de Faenza, bourg d'Italie où la poterie a été inventée; *faisan,* de Phasis, fleuve de la Colchide, d'où cet oiseau fut apporté. Le mot *pêche,* en latin *persicum,* et en Italien *persica,* est simplement un fruit de la Perse; l'adjectif est devenu un substantif. *Indigo,* du latin *indicum,* est devenu par le même procédé un substantif; c'est le bleu de l'Inde.

La *turquoise* est une pierre qui vient de la Turquie. Autrefois l'adjectif *turc, turque* se disait *turquois, turquoise,* de même qu'on disait aussi *canadois* et *canadoise,* en parlant des indigènes du Canada. Ceux qui portent des *cravates,* — et, aujourd'hui c'est tout le monde, — croient peut-être que c'est là un mot d'origine bien française; il en a, du reste, toutes les apparences; et pourtant il est tiré du nom des *Cravates* ou *Croates,* habitants de la Croatie, qui vinrent au service de la France, et qui portaient autour du cou un morceau d'étoffe ressemblant à une cravate. *Solécisme* a encore une singulière origine. Il s'était établi dans la ville de Soloï ou Soles, en Silicie, une colonie d'Athéniens qui, par suite de leur mélange avec les habitants, en étaient venus à parler très mal la langue de Démosthènes. De là le substantif *solokismos* qui désignait une tournure ou une expression vicieuse. *Solokismos* a fait *solécisme.*

Je pourrais, si le temps me le permettait, donner ici une liste des noms de forts, villages, paroisses, villes, etc., qui renferment tout un épisode historique. Et pour cela il ne serait pas nécessaire de sortir de cette province. Mais je n'apprendrais à mes lecteurs rien de nouveau, et je dépasserais les limites que je me suis assignées.

A côté de ces mots qui nous parlent de poésie, de religion, de morale, d'histoire et de géographie, il y a encore une foule d'autres termes qui ont été détournés de leur sens primitif, et qui ne disent plus ce qu'ils devraient dire. Les uns ont été relevés, anoblis en quelque sorte; d'autres sont déchus, ont dégénéré. Ainsi le mot *cicérone* ne désigne pas un personnage d'une condition bien relevée; et cependant il a été emprunté au nom de l'un des plus grands orateurs de l'antiquité. Je crois qu'on a eu tort de descendre Cicéron de son piédestal pour l'assimiler à un guide parleur, à un hâbleur. Et ce mot *hâbleur* lui-même, pourquoi lui a-t-on donné cette acception qui le déclasse, quand le verbe espagnol *hablar,* d'où il est tiré, signifie simplement parler. Il est vrai que, quand nous disons d'un individu qu'il *fait* le mouchoir, ou qu'il est un *faiseur,* nous usons d'un procédé analogue.

Quand nous parlons d'une *prude*, nous n'avons pas l'intention de faire par là un éloge ; et, cependant, *prude*, *pruderie* ont la même origine que *prudence*, *prudent* et *preux*, qui sont loin de dire la même chose. Le mot *libertin* n'est que le diminutif de *libre*, et pourtant nous en avons fait un qualificatif qui sonne assez mal, de même que son substantif *libertinage*. *Faquin* n'est pas non plus une appellation très enviable, et pourtant l'italien *facchino*, avec lequel nous l'avons formé, signifie seulement *porteur*, *porte-faix*. *Virtuose*, qui signifie un musicien habile, est exactement le même mot que *vertueux*. Les anglais disent qu'une ville contient mille *âmes*, mais qu'une fabrique emploie cent *mains* (a hundred hands). Le mot *homme* n'est donc plus qu'une main. Mais, ne nous hâtons pas de condamner, nous qui disons que les campagnes, que les usines manquent de *bras*. Du reste, quand nous parlons de cavalerie, ne disons-nous pas : un corps de cinq cents *chevaux ?* Le cavalier disparaît, absorbé par l'importance de sa monture. Toutes les recrues des corps de cavalerie vous diront, au surplus, que cette absorption est une grande vérité.

Le mot *supplice* implique une idée de souffrance, de torture, de mort. Et, pourtant, anciennement il voulait dire simplement prière, supplication.

Nous disons : bête comme un *âne*, quoique les ânes ne soient pas moins bien doués que la plupart des autres animaux. Nous croyons avoir décoché une des plus fortes injures quand nous avons lancé à quelqu'un l'épithète de *chien*. Et, néanmoins, trouvez-moi bien des hommes qui fassent preuve d'autant d'affection, de fidélité, de dévoûment et de reconnaissance que le chien, dans la bonne comme dans la mauvaise fortune ; qui pratiquent surtout aussi admirablement le pardon des injures et l'oubli des mauvais traitements. On dit encore : sot comme une *oie ;* et, pourtant, il serait facile de prouver que l'oie n'a jamais fait le demi-quart des sottises que les hommes ont écrites avec ses plumes.

Voyons maintenant les expressions que l'usage a relevées et anoblies.

Quand nous disons d'une personne, d'une chose, qu'elle est *sublime*, nous employons un des qualificatifs les plus forts que nous ayons dans notre langue. Examinons cependant quelle en est l'humble origine. " Il s'employa d'abord, dit M. Michel Bréal, en parlant des esclaves qui, quand ils avaient commis quelque méfait, étaient attachés sous le seuil supérieur de la porte pour être battus de verges. *Sublimem te rapiam* est une expression fort fréquente chez les poètes comiques pour dire : " Je te ferais suspendre pour recevoir des étrivières." Le philologue allemand Ritschl fait remarquer que les meilleurs manuscrits de Plaute ont *sub limen*, ce qui nous donne l'étymologie. L'adjectif *sublimis* a ensuite signifié, d'une façon générale, " enlevé de terre." Enfin, se détachant de plus en plus de son origine, *sublimis* a désigné tout ce qui est ou paraît suspendu en haut, les oiseaux, les nuages, le ciel, et particulièrement ces figures ailées traversant l'espace, comme on représente les divinités. Enfin, *sublimis* a été usité dans le sens de " haut, fier, généreux, désintéressé, *sublime*."

Croix et *crucifix* sont des expressions qui provoquent aujourd'hui notre vénération ; et cependant, dans l'origine, ils infligeaient une flétrissure. Il en est de même de *martyr*, qui ne signifiait d'abord qu'un simple témoin. Aujourd'hui ce mot est revêtu d'une auréole qui le transfigure. *Gêne*, sans être une expression tout à fait à son aise, est pourtant encore bien au-dessus du mot *géhenne* (enfer), dont on l'a tirée. Quand on parle d'un enfant gâté, d'un enfant malin, n'est-ce pas que ces expressions *gâté* et *malin* sont singulièrement adoucies par le voisinage du mot *enfant*, qui leur prête un peu de son charme innocent ?

Il y a encore une autre manière de détourner les mots de leur sens primitif pour en

construire ces espèces d'expressions amphibies qu'on décore poliment du nom d'euphémismes.

Ainsi, un *industriel* ne veut pas toujours dire un homme qui s'occupe d'industrie, de même qu'un *chevalier d'industrie* n'a rien de commun avec les Roland et les Bayard. Un *pot de vin* est une petite politesse que les lois du jour jugent assez sévèrement; et ce que nous appelons *eau-de-vie* est bien, dans un grand nombre de cas, plutôt une *eau de mort.* Les sauvages, du reste, avaient peut-être trouvé un excellent moyen terme en l'appelant *eau de feu.*

C'est encore une singulière manière de parler que d'appeler le poison de la *poudre de succession,* ou de dire, comme les Italiens, d'un individu qu'on a empoisonné ou poignardé: "E stata ajutata la sua morte." Sa mort a été aidée, on lui a donné un petit coup d'épaule. Mais la perle se trouve dans les îles Fidji, où l'on appelle un porc rôti : un *porc court,* et un être humain rôti: un *porc long.*

Et, au surplus, que ne trouverions-nous pas, si nous voulions un peu approfondir le sens de ces euphémismes dont notre presse est peut-être trop prodigue: rouge, bleu, grit, tory, libérâtres, castors, petits-manteaux, sénécaleux, etc.

A côté de ces singularités, il y a encore plusieurs mots qui ont subi une certaine dépréciation par l'usure, comme les pièces de monnaie qui ont beaucoup circulé. Ainsi un grand nombre de personnes ne vous diront plus: "c'est la vérité;" mais, "c'est la vérité vraie," ou "la vraie vérité." On ne dit point non plus: "je vous donne ma parole," mais "je vous donne ma parole d'honneur," et dans les circonstances graves: "ma parole d'honneur la plus sacrée." De même, on ne se contente point d'une affirmation, d'un serment, il faut une affirmation "solennelle," un serment "solennel."

Je me réserve l'occasion de dire, plus tard, d'où vient cette manie d'exagérer que nous avons transformée en habitude. Pour le moment, j'aime mieux revenir au sanscrit et à l'arabe; le terrain est aussi fertile et moins dangereux.

J'ai donné, il y a un instant, l'étymologie du mot *asthme,* des deux racines *as* et *mu.* Voici maintenant la racine *plu,* couler, courir, que vous reconnaîtrez facilement dans *pluie, fleuve, effluves, flux* et *reflux, flot, affluent, fluide,* etc., dans l'anglais *to flow* et dans l'italien *fiume.* L'*l* est disparu dans le mot italien, parce que cette langue n'admet pas facilement la réunion de certaines consonnes qui offrent un conflit de son. Ainsi, flamme fait *fiamma,* blâmer, *biasimare;* plein, *pieno,* etc. C'est ce qui explique l'absence de certaines lettres de la racine dans plusieurs cas.

Le verbe *swan,* retentir, crier, a donné le français *son, sonner,* etc., l'anglais *sound,* et probablement *swan,* cygne, l'oiseau qui chante avant sa mort, l'italien *suono, suonare.* Le verbe *ang* veut dire rapprocher, resserrer; d'où nous avons *angle, angoisse, angine, angustie.* Quand nous avons du chagrin, nous disons que nous avons le "cœur serré"; c'est la véritable signification du mot *angoisse.* Le verbe *Kert,* qui signifie couper, a donné *court* et ses derivés, ainsi que l'anglais *short* et *curtail.*

Le verbe *man* veut dire penser, parler, informer; vous le reconnaîtrez dans les mots *mander, mandat, démence, mentir, mensonge, reminiscence.* Et, l'homme étant l'être pensant et parlant, nous avons en anglais le mot *man,* puis *mind* et *mean,* dans le sens de signifier. *Wir* représente la couleur des jeunes plantes; il a donné le latin *viridis,* le français *vert,* l'italien *verde,* et l'anglais *verdancy, verdant.* Puis, de l'idée qu'une plante jeune et verte est robuste et vivace, on a tiré la signification de vigueur: *vir, virilis* en latin; *viril, virilité, virulent, virulence,* en français.

Le verbe *al* veut dire monter, s'élever ; il a formé le latin *altus*, d'où nous avons tiré *altier*, *haut* (qui s'écrivait *hault*), puis *hauteur* (haulteur), *altitude*, etc.

Mâg signifie mouvoir, agir. Nous avons directement de cette racine : *mécanique*, *machine*, *machination*. Les mots anglais *make*, *maker* ont la même origine (grec *mecanè*, latin et italien *machina*). Le verbe *braïs* signifie trembler, craindre. Il a donné *frisson* et *frissonner*, le latin *frigus* et *frigidus*, parceque le froid fait trembler. C'est de la que vient aussi notre mot *froid* qui s'écrivait autrefois *freiz*, comme le prouve la Chanson de Roland : "Et endurer et granz chauz et granz freiz." Observez l'analogie que présente l'anglais *freeze*, *fright*, et l'italien *freddo*. *Frise*, *friser*, *frison*, viennent encore de la même racine. On saisira tout de suite, en effet, la proche parenté qui existe entre *friser* et *frissonner*.

Vous seriez sans doute curieux d'apprendre d'où vient le mot anglais *heart ?* Il vient du mot sanscrit *Hri*, qui signifie également trembler, s'émouvoir, palpiter. *Hri* a fait le substantif *Herd* et *Herdayan*, le palpitant, l'objet qui palpite, c'est-à-dire le cœur, *heart*. C'est de la même racine que viennent le latin *horreo*, *horresco*, *horror*, et le français *horreur*, *horrible*, etc.

Le verbe *dram*, qui a la même signification, a donné le grec *tremein*, le latin *tremere*, l'italien *tremare*, le français *trembler*, l'anglais *tremble*, et leurs derivés. Notez que, dans ces trois racines, c'est la lettre *r* qui indique le tremblement.

Prenons maintenant le verbe *wap*, qui veut dire coudre, tisser, etc. Nous allons en tirer d'abord les mots *weave* et *weaver*. Puis de son substantif *wapas* ou *wapus*, nous aurons les mots latins *opus*, *operari*, qui nous donnent en italien *operare*, *operaio*, *opera ;* puis, en français, *opérer*, *ouvrier*, (qui s'écrivait *ovérier*), *ouvrer*, *ouvrage* et *oeuvre*.

Le verbe *stab* signifie attacher, fixer. Il donne le français *stable ;* l'anglais *stop* et *stamp* et probablement *stump ;* puis encore, le français *étampe*, *étamper*, (ancienne orthographe, *estampe*, *estamper*), *étable* (estable) ; enfin *établir* (establir), *stabilité*, etc.

Le verbe *luth* signifie entamer, enlever, blesser. Les latins en ont fait *laesio*, *laedere*, d'où nous avons tiré *lésion* et *blessure*. Mais souvenons-nous que ce verbe signifie aussi retrancher, entamer. C'est pourquoi nous en avons formé *lésiner*, *lésinerie*, c'est-à-dire retranchement, économie, auxquels l'idée de blessure a attaché un sens d'avarice, de mesquinerie.

Le verbe *mâdh* ou *matran* signifie *mesure*. De la première forme nous avons fait *modeste*, *modestie*, *modéré*, *modération* ; de la seconde nous avons tiré *mètre* et tous ses dérivés.

Le verbe *wal* signifie tourner, entourer, et par suite protéger. De là nous avons *val*, *vallon vallée*, *circonvallation*, et l'anglais *wall* (mur).

Djaks veut dire rire, badiner. Nous avons de là le latin *jocus*, *jocari ;* l'italien *gioco*, *giocare*, *gioja*, *giojoso ;* le français *jeu*, *jouer*, *joie*, *joyeux*, et l'anglais *joke* et *joy* avec ses dérivés. L'adjectif *jovial* ne vient pas de la même racine (qui aurait donné *joyal*) ; il est tiré de *jovis*, génitif de Jupiter, parce qu'on considérait que du maître de l'Olympe procédaient toute joie et tout contentement.

Quelques-unes de ces transformations sembleront peut-être un peu étranges. Et pourtant, en y réfléchissant et en tenant compte de la manière dont toutes les langues se sont formées par un procédé lent d'assimilation, on trouve qu'elles n'offrent rien de bien étonnant. "Tant que l'homme conserve la juste idée de l'organisation des mots ; tant qu'il comprend bien les racines, il prononce bien et accentue toutes les syllabes ; mais à mesure que cette connaissance s'efface, certaines lettres, certaines syllabes s'amoindrissent et finissent par disparaître." Considérons comment le latin *cognoscere* a pu faire, en italien *conos-*

cere, en français, *connaistre, connoître*, puis *connaître* ; comment, du latin *benedicere*, on a fait l'italien *benedire*, et le français *bénir ;* nous pourrons alors, d'une façon relativement facile, expliquer des dérivations qui nous paraissent, à première vue, manquer un peu de suite.

Je n'ai cité qu'un bien petit nombre des racines sanscrites dont nous avons fait notre profit, en les retrouvant à travers le latin et le grec ; il faudrait plusieurs volumes pour les consigner toutes. A part cela, nous avons encore fait de nombreux emprunts directs à la langue arabe. Plusieurs des termes usités en mathématiques, comme *algèbre*, *chiffre*, etc., sont des mots arabes francisés. *Alcôve* vient de l'arabe *al-kobba*, qui signifie petite chambre. *Assassin* est formé de l'adjectif *hatchatchi*, dérivé lui-même du substantif *hatchitché*, parce qu'un chef arabe faisait prendre du hatchitche aux hommes de sa troupe, qui, surexcités par cette terrible drogue, tuaient et massacraient sans merci, sur un signe de sa main.

Babouche est le mot persan *papouche*, qui nous est venu par l'arabe, lequel, n'ayant point la lettre *p*, l'a remplacée par un *b*.

Carafe vient du verbe *garafa*, qui signifie puiser. On trouvera peut-être dans cette racine la raison pour laquelle un si grand nombre de personnes prononcent *garafe*.

Girafe vient également de *zourafa*, qui a la même signification.

Hasard offre une très grande ressemblance avec az-zhar, nom du dé à jouer chez les Arabes.

Jupe, *jupon*, viennent de *dzouppa*, qui a la même signification.

Lilas descend en ligne directe de *lilac*. L'anglais *lilac* a même conservé l'orthographe. et la prononciation.

Luth vient de *Alloudh*, dont le portugais *alauda* se rapproche encore davantage.

Makhazin, qui en arabe signifie dépôt, nous a donné *magasin*.

Mascarade a une grande ressemblance avec *maskhara*, qui signifie bouffon, bouffonnerie.

Enfin, *mesquin* est une véritable photographie de l'arabe *meskhin*, qui veut dire pauvre, nécessiteux.

Je m'arrête ici.

En voilà suffisamment, non pas pour nous éclairer et nous instruire beaucoup, mais pour nous faire réfléchir et nous inspirer peut-être le désir de nous renseigner davantage sur le sujet. Dans les œuvres du Créateur, ce qui se dérobe à nos sens n'est pas moins admirable que ce qui frappe et étonne le regard. Le très petit est, d'une certaine manière, aussi considérable que le très grand ; il ne s'agit que d'aller le découvrir et l'examiner chez lui, à l'aide des instruments que notre intelligence a créés, et qui nous révèlent un guerrier armé de toutes pièces dans l'insecte qui se cache sous un grain de poussière, et un soleil immense, d'un diamètre bien supérieur à celui de l'orbite lunaire, dans cette petite étoile dont la lumière tremble là-haut, tout au fond du firmament.

Pour l'homme qui étudie sérieusement, il n'y a presque pas de petites choses, et il peut tirer un exemple utile, un enseignement salutaire, aussi bien de quelques syllabes obscures, d'un mot oublié, que des plus grandes œuvres du génie humain.

XIV — *Le dernier boulet — Nouvelle historique —*

Par JOSEPH MARMETTE.

(Lu le 26 mai 1885.)

Au milieu du quinzième jour de mai 1760, la route qui mène de Beauport à Québec offrait à l'œil le spectacle le plus étrange et le plus triste qui se puisse voir. Sur le chemin rompu en maints endroits par la lutte du printemps contre l'hiver à peine terminé, à travers les flaques d'eau, dans les ornières boueuses où elles enfonçaient jusqu'à mi-jambe, se traînait une longue file de créatures humaines qui s'avançaient péniblement dans la direction de la ville. Courbées vers la terre, pliant sous le poids d'un fardeau, tirant ou poussant de petites charrettes à bras, chargées de victuailles, elles allaient comme des âmes en peine, chancelant presque à chaque pas sur la route devenue fondrière.

Pour traîner ces voitures, pour porter ces comestibles, pas un cheval, pas une bête de somme. Dame, il y avait longtemps que le dernier cheval de la côte de Beaupré avait été mis en réquisition pour le service du roi de France, massacré ou brûlé avec les bestiaux par les soldats du roi d'Angleterre. Deux grands souverains s'en mêlant, vous comprenez que la ruine de ces petites gens avait été bientôt consommée ! Donc, pour toutes bêtes de somme des vieillards infirmes, hors d'état de porter les armes, des femmes, des enfants au-dessous de quatorze ans. Quant aux jeunes gens et aux hommes faits qui avaient pu survivre aux dernières campagnes, qui n'étaient point restés sur les champs de bataille de la Monongahéla, de Chouéguen, de William-Henry, de Carillon, de Montmorency, des plaines d'Abraham ou de Sainte-Foye, ces rares survivants de nos miliciens — trois mille hommes à peine — poussaient encore le dévouement, la sublime folie, jusqu'à assiéger Québec, avec les trois ou quatre régiments décimés qui achevaient de mourir pour le service du roi Louis XV dit le Bien-Aimé, qui s'en souciait vraiment comme d'un fétu.

Après la bataille du 13 septembre, à laquelle il n'avait malheureusement pu prendre part, le chevalier de Lévis, retourné aussitôt à Montréal pour y organiser la résistance suprême, était redescendu au printemps sous les murs de la capitale, où, avec un peu plus de six mille hommes manquant de tout, épuisés par des marches forcées dans les neiges fondantes, il avait accablé d'une défaite humiliante les sept mille hommes de troupes anglaises bien reposées et repues. Terrifié, Murray s'était renfermé dans la ville que le général français tenait maintenant assiégée, depuis le 29 avril, avec un corps d'armée réduit à moins de six mille hommes. Les nôtres n'avaient pour tout matériel de siège, que quinze mauvais canons, dont le plus gros ne portait que douze livres de balles. Encore avait-on si peu de munitions que chacune de ces pièces ne tirait guère que vingt projectiles par vingt-quatre heures. Les provisions qu'on avait recueillies en descendant de Montréal à Québec, étaient épuisées depuis plusieurs jours. Après avoir dévoré les maigres vivres qu'on avait pu glaner chez les habitants de Sainte-Foye, de Lorette et de Charlesbourg, l'armée, pourtant réduite par les pertes du dernier combat, allait voir le spectre de la

famine tendre sa main de squelette au fantôme à tête de mort qui plane au-dessus des champs de bataille, lorsque M. de Lévis s'était avisé de rançonner à leur tour les habitants de Beauport et de l'Ange-Gardien. Quoique la côte de Beaupré eût été dévastée l'année précédente, bien que ses habitants eussent tout perdu, habitations, récoltes, meubles et bestiaux, et qu'ils eussent été obligés — après avoir vécu plusieurs mois comme des fauves dans la forêt — de se cabaner durant l'hiver comme des sauvages à la lisière du bois, ces misérables devaient pourtant bien avoir encore quelque chose à mettre sous la dent, puisqu'ils n'étaient pas encore morts de faim ! Eh bien, cette bouchée dernière qui leur restait, M. de Lévis n'avait pas craint de la leur demander, à ces infortunés que nous avons vus charroyer, à force de bras, vers le camp français, à peu près tout ce qu'ils avaient de provisions de bouche. Ces besogneux sublimes allaient porter le viatique aux braves prêts à périr en livrant la dernière bataille. Il est vrai que pour tous, mourir paraissait la dernière action qui leur restât à faire, et chacun s'y préparait sans murmure, tout simplement, avec un stoïcisme amené du reste par la succession ininterrompue des malheurs précédents.

Et, pendant que ces gueux héroïques agonisaient pour leur roi, Sa Majesté Louis XV filait d'heureux jours dans les petits appartements dorés de Versailles, avec la belle marquise de Pompadour, enchantée que la perte du Canada pût dérider le front de son royal amant.

N'était-ce pas la plus navrante des misères que celle de ces êtres débiles changés en bêtes de charge, et venus de si loin, par des chemins atroces, ravitailler les débris de troupes que la cour abandonnait à la mort avec une si coupable indifférence !

Ahanant sous l'effort des fardeaux longtemps portés, ou des pieds tirés avec peine de la boue épaisse, ces pauvres créatures allaient toujours sans s'arrêter jamais, de peur de n'avoir plus la force de se remettre en marche. C'est ainsi, dans ces temps admirables, que ceux qui ne pouvaient pas se battre s'en allaient redonner quelque force à ceux-là qui de leur corps faisaient un dernier rempart à la patrie.

En tête du convoi, attelé à une petite charrette, marchait un invalide. C'était un homme de soixante ans mais vert encore, à l'attitude martiale quand il se redressait. Pour le moment, il était tout courbé, tirant le véhicule, et sa jambe de bois donnant comme des tours de vrille dans le sol, à chacun de ses pas ; ce qui imprimait à son corps un déhanchement pénible qui aurait dû l'épuiser depuis longtemps, s'il n'avait eu des muscles de fer, une volonté d'acier. Mais sa respiration stridente, ses cheveux collés aux tempes, la sueur qui lui ruisselait sur la face, témoignaient de ses efforts.

Derrière la charrette et la poussant de ses deux mains — pas bien fort, la pauvre ! — suivait une femme de vingt ans, la bru du vieillard. Et, dans la voiture, sur des lièvres et des perdrix entassés pêle-mêle, était couché un enfant au maillot, celui de la femme. Malheureuse créature, âgée d'un mois et conçue dans les larmes, au mois de juillet précédent, entre deux batailles dont l'une fut notre avant-dernière victoire et l'autre un irréparable désastre.

Jacques Brassard, le père de l'enfant, milicien incorporé dans une compagnie de la marine, appelé sous les armes au commencement du printemps, avait laissé sa famille à l'Ange-Gardien. A peine y avait-il quelques semaines que les troupes étaient campées à Beauport, que Brassard y avait vu arriver son père et sa jeune femme, obligés de fuir devant les soldats anglais, et de laisser derrière eux leur maisonnette avec tout ce qu'ils

possédaient au monde. Quelques jours plus tard, au mois d'août, Brassard avait été dirigé sur Québec, pour servir dans l'artillerie de rempart. Depuis lors on ne l'avait point revu. Vivait-il encore, avait-il été tué à la bataille du 13 septembre, ou faisait-il partie de ceux-là qui maintenant tenaient à leur tour la capitale assiégée? Les infortunés n'en savaient rien. Après avoir passé le plus terrible des hivers à l'Ange-Gardien, évacué par l'ennemi, et dans une cabane de branchages élevée par le vieux sur l'emplacement de leur maison, que les soldats de Montgomery avaient brûlée; après avoir donné le jour à son enfant dans une hutte plus pauvre encore que l'étable où naquit le Christ, cette faible femme, ce vieillard infirme, profitaient de l'occasion du convoi pour aller s'informer si le cher absent vivait encore ou ne les avait pas quittés pour toujours. Vous comprenez donc que pour eux il n'y avait pas de fatigue qui les pût empêcher d'arriver là-bas, sur ces collines désormais fameuses où se jouait la partie suprême qui allait décider du sort de tout un peuple.

A mesure qu'ils approchaient, le grondement des canons qui tonnaient sur les hauteurs leur parvenait de plus en plus distinct. Mais c'était du côté de la ville qu'ils étaient plus précipités, les Anglais tirant dix coups de feu contre les nôtres un seul. Sur les remparts qui regardaient la plaine, à chaque instant éclatait un éclair, suivi d'un gros flocon de fumée couleur de souffre, qui bondissait, s'arrêtait, se tordait sur lui-même, et s'élevait lentement en blanchissant dans l'espace.

On arrivait au pont de bateaux jeté l'été précédent par les Français sur la rivière Saint-Charles. Non détruit par ceux-ci après la retraite précipitée du 13 septembre, et conservé par les Anglais, qui, au dire de Knox, y entretinrent une garde tout l'hiver, jusqu'à l'arrivée des troupes françaises, ce pont volant avait bien un peu souffert de la débâcle. Mais le général Lévis l'avait fait réparer suffisamment pour permettre au convoi de passer l'eau. Il va sans dire que nos troupes étaient maîtresses non seulement des plaines d'Abraham et de Sainte-Foye, mais encore de tout le terrain qui s'étendait depuis les dernières maisons de Saint-Roch, alors groupées dans les environs de l'Intendance, jusqu'à l'Hôpital-Général et au-delà, l'ennemi se terrant dans la ville. Pour prendre la muraille de la place à revers, une de nos cinq petites batteries de siège était même élevée sur la rive gauche de la rivière Saint-Charles, quelque part où le Saint-Roch actuel mire ses usines et ses quais dans l'eau qui coule au pied du pont Dorchester.

Du côté de la ville, une redoute s'élevait à la tête du pont volant. Une garde française l'occupait. Quand le vieux qui marchait toujours en tête fut à portée de voix:

— Eh! père Brassard, est-ce bien vous? lui cria-t-on de la redoute.

Lui, à qui cette voix semblait familière, mettant sa main au-dessus de ses yeux pour mieux distinguer celui qui lui parlait:

— Est-ce toi, Jean Chouinard?

— Oui, père.

— Tu vas donc — et la voix du vieux se prit à trembler — tu vas donc pouvoir me donner des nouvelles de mon gars?

Derrière le vieillard, la jeune femme était secouée par un frisson d'angoisse, comme une feuille de tremble agitée par le vent.

— Votre garçon, père Brassard, il est en haut, sur le coteau, de service à la première batterie que vous y rencontrerez.

— Ah !... fit le vieux avec un long soupir de soulagement.

— Le bon Dieu soit béni ! dit la jeune épouse.

— Allons ! reprit gaîment l'invalide en se remettant en marche avec des demi-tours plus vifs de sa jambe de bois. Et le reste du convoi de suivre, car c'était au quartier général, là-haut, qu'il fallait porter les vivres.

Le chemin qu'ils suivaient passait à travers champs, à peu près à l'endroit où se joignent maintenant Saint-Roch et Saint-Sauveur, et grimpait sur les plaines par la côte Sauvageau.

D'où ils cheminaient, les gens du convoi apercevaient distinctement à gauche les maisons de la ville, dont le grand nombre, incendiées par les Anglais lors du premier siège, dressaient leurs cheminées calcinées vers le ciel, comme dans un élan de désespoir de grands bras décharnés, tandis que les embrasures des fenêtres crevées regardaient comme des yeux morts. Au dessus s'étendait un ciel triste, sans soleil, où se traînaient de longues nuées basses et brumeuses, que le vent fauchait en les emmêlant avec l'épais nuage de fumée de poudre, qui largement montait de la plaine et des remparts. Et, maintenant, après chaque décharge d'artillerie, on entendait les rauques grondements des boulets qui se croisaient là-haut en hurlant la mort.

Il était quatre heures quand le convoi enjamba la crête du coteau. Déviant un peu sur la gauche, une parallèle couronnait les mamelons qui faisaient face à la ville, à huit cents verges des murailles. C'était le camp des assiégeants. Derrière les épaulements en terre, grouillait cette misérable armée de moins de six mille désespérés, qui persistaient avec quinze méchants canons, à bombarder une place défendue par cent cinquante bouches à feu du plus fort calibre. Et depuis deux semaines, chacun de ces hommes avait dû vivre et se battre avec une ration d'un quart de livre de viande et d'une demi-livre de pain par jour. [1]

L'artillerie anglaise faisait rage. Ses projectiles pleuvaient dru comme grêle et labouraient le sol jusqu'à deux milles au delà du camp français. Comme les gens du convoi auraient été trop exposés, à s'aventurer plus loin que le bord du coteau, le général envoya au-devant d'eux pour recueillir les provisions qu'ils apportaient.

Le père Brassard, une fois débarrassé des siennes, demanda à l'officier qui commandait le détachement, la permission de pousser jusqu'à la batterie la plus rapprochée, où se trouvait son fils. Au même instant, un boulet vint s'enterrer à cent pieds de là et fit, en crevant le sol, jaillir des cailloux jusque sur les gens du convoi, dont la majeure partie, composée de femmes et d'enfants, prit panique et courut se mettre à l'abri dans la côte.

— Vous voyez à quoi vous vous exposez ! dit l'officier à Brassard, resté avec sa bru et quelques autres.

— Bah ! mon lieutenant, ça me connaît les boulets, fit l'invalide en montrant sa quille de bois.

— Raison de plus pour veiller à conserver l'autre, mon brave.

— Oh ! je n'ai qu'un regret, repartit le vieux en se frappant la poitrine, c'est de ne l'avoir pas reçu là ! Il y a bien des choses tristes que je n'aurais pas été forcé de voir.

— Vous persistez donc ?

— Oui ; je voudrais embrasser encore une fois mon garçon.

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[1] Journal de Knox, vol. II, p. 307.

— Allez....

Le vieux partit en sautillant avec sa jambe de bois. Sa bru le suivait.

— Mais pas vous, au moins, lui dit l'officier en l'arrêtant par le bras.

— Son garçon, c'est mon mari, dit-elle.

— Alors, allez-y donc, à vos risques et périls, fit le lieutenant avec un haussement d'épaules.

La jeune femme suivit le vieillard, son enfant serré contre son cœur. Un, par exemple, qui ne se doutait guère du danger, celui-ci, qui, les lèvres avides au sein de sa mère, puisait inconscient la vie au milieu de la mort. Car ils marchaient sur des fosses tout fraîchement remplies des malheureux récemment tués. Et puis, au dessus, autour d'eux, la mort insatiable poussait dans l'air de sinistres clameurs.

Ils touchèrent pourtant sans encombre les derrières de la première batterie. Mais quand ils voulurent passer outre on les arrêta. Ils exposèrent l'objet de leur désir.

— Braves gens, leur dit la sentinelle, savez-vous que ça n'est pas sain du tout par ici. Voilà aujourd'hui notre dix-septième tué qu'on emporte là-bas.

— Oh ! dites-moi, s'écria la jeune femme, est-ce que Pierre Brassard... ?

Elle ne put finir, les mots s'étranglaient dans sa gorge.

— Pierre Brassard ? reprit le soldat, je l'ai vu servant sa pièce, il y a dix minutes.

— Oh ! Monsieur ! laissez-moi le voir, je vous en supplie !

— Eh ! bonnes gens, je n'y peux rien, moi. Mais, tenez, voici mon capitaine ; adressez-vous à lui.

Un éclair de joie illumina la figure du vieillard.

— Pardon, mon commandant, dit-il à l'officier qui passait distrait, ne me reconnaissez-vous pas ?

— Tiens, Brassard ! Mais que diable viens-tu faire ici, mon vieux ! Tu n'es plus guère propre au service !

— Hélas ! non, mon capitaine. Mais j'ai profité du convoi de vivres pour tâcher de revoir un peu mon garçon, dont on était sans nouvelles depuis l'automne passé. Et c'est sa femme que voici. Nous refuserez-vous, mon commandant ?

— Mais il est de service à sa pièce, et ça chauffe où il est, je vous en avertis !

— Oh ! s'il vous plaît, Monsieur ! murmura la jeune femme de sa voix la plus douce.

— Venez-donc, fit l'officier qui les guida lui-même vers l'embrasure de l'épaulement dans laquelle était la pièce du canonnier Brassard. Avisant un artilleur assis sur une pyramide de boulets, et qui se reposait de son tour de service :

— Noël, lui dit le capitaine, remplace un peu Brassard, que son père et sa femme viennent voir. Eh ! là-bas, Brassard, avance à l'ordre !

L'artilleur, en train d'amorcer le canon, se retourna. En apercevant sa femme et son père, la face lui blanchit sous la couche de poudre qui la recouvrait en partie, et, un instant il s'appuya sur l'affût pour ne pas chanceler.

— Viens donc, dit l'officier. Noël te remplace.

Il y eut trois cris délirants qui se perdirent dans une détonation voisine, et puis des bras qui s'enlacèrent, et des lèvres sur lesquelles trois âmes se pâmèrent avec des spasmes d'ivresse.

La première effusion passée, l'artilleur s'aperçut du danger que couraient les siens, et s'empressa de les entraîner plus près de l'épaulement. Il fit asseoir sa femme par terre, à

l'endroit où ces sortes de travaux ont le plus d'épaisseur. Le vieux ne voulut pas, lui. Ça ne lui allait pas de baisser la tête devant les boulets anglais... trop d'honneur à leur faire.

Ce qui se dit alors entre ces trois êtres aimants que séparait la guerre maudite, vous le pouvez deviner. De ces paroles bien simples, mais tellement accentuées par les battements du cœur, et soulignées par la caresse inexprimable du regard, que des mots écrits n'en sauraient jamais rendre la poignante expression.

— Et ce petit... ? dit le soldat, qui, les yeux humides, regarda l'enfant.

Entre deux coups de canon, celui-ci s'était endormi sur le sein maternel, et souriait, sa mignonne bouche entr'ouverte où perlait des gouttes de lait.

— C'est vrai, tu ne le connais pas encore, et pourtant c'est notre enfant. Tu te souviens... ?

— Oui... fit-il.

— Embrasse-le, Pierre.

Il se baissa, prit avec précaution dans ses grosses mains ce tout petit être fait de son sang, et le baisa sur la joue. La barbe du soldat, imprégnée de poudre, fit deux taches noires sur le visage de l'enfant ; ce qui les fit rire tous trois.

— Est-ce un garçon ? demanda-t-il.

— Oui.

— Tant mieux !

— Oui ! gronda le vieux, pour faire encore de la chair à boulet comme nous !

Il y eut entre eux un moment de silence. Car ces pauvres gens connaissaient assez tout ce que la guerre a d'effroyable pour les humbles que la gloire en courant écrase sous son char.

— Enfin, reprit le vieillard, puisse-t-il vivre en des temps meilleurs que ceux-ci ! Car depuis des années, c'est à jalouser ceux qui ont eu la chance de partir avant nous.

Le jour baissait. Le vieillard fut le premier à s'en apercevoir.

— Ma fille, dit-il, voici l'heure de nous en aller. On ne nous souffrirait pas longtemps, car nous sommes ici des bouches inutiles, et tu sais comme moi que le pain et la viande y sont rares.

Et puis, comme il voyait que la seule idée de leur départ bouleversait son fils, il ajouta pour le distraire un peu :

— Je vois qu'on va tirer ta pièce. Demande donc à celui qui tient la mèche de me laisser mettre le feu. Ça me rappellera l'ancien temps où, comme toi, j'étais canonnier.

Pierre s'approcha du canon avec son père et parla au soldat, qui tendit la mèche au vieil invalide :

— Volontiers, l'ancien, dit-il, si ça peut vous être agréable.

Au commandement : "Haut la mèche !" le vieux se redressa comme autrefois.

— Feu ! cria l'officier.

Le canon tonne et se cabre. Mais en même temps, un boulet venu de la ville frappe la pièce, et, ricochant, coupe le vieillard en deux et fracasse la poitrine du fils. Le vieux tombe comme une masse inerte, tandis que Pierre, frappé de flanc, tourne sur lui-même, et, pantelant, s'abat à côté de sa femme qu'il inonde d'un flot de sang.

D'abord paralysée par l'épouvante, celle-ci resta sans mouvement, sans voix. Et puis, avec un cri qui n'avait rien d'humain, elle se jeta sur le corps de son mari. Le cœur

emporté, il était étendu sur le dos, les yeux démesurément ouverts. Tout auprès, l'enfant, échappé des bras de sa mère et roulé dans le sang de l'aïeul et du père, poussait de pitoyables vagissements.

Comme on se précipitait vers ce lamentable groupe — la guerre est sans merci — trois coups de clairon retentirent.

— Cessez le feu ! commanda l'officier.

Un aide-de-camp accourait.

— Qu'on encloue les pièces, cria-t-il, et qu'on se prépare à battre en retraite. Une demi-heure pour enterrer les morts !

M. de Lévis venait d'apprendre que Vauquelain, écrasé par le nombre, avait eu nos derniers vaisseaux foudroyés par l'Anglais. C'était l'espérance suprême que nous arrachait le ciel.

Comme la nuit tombait, dans une fosse creusée en toute hâte, pêle-mêle on jetait les morts de la journée. Ils tombaient avec un bruit mat, l'un couvrant l'autre, et mêlant leur sang dans un dernier holocauste à la France.

Autour du trou béant, muets comme des fantômes, s'inclinait un groupe d'hommes qui pleuraient. Son surplis se détachant lumineux au premier rang sur ces ombres confuses, un prêtre doucement bénissait les martyrs. A son côté, soutenue par un sergent à barbe grise, la femme du canonnier Brassard s'affaissait sous le poids de sa désolation.

Enfin, on entassa la terre sur cet amas confus de cadavres, et ce fut tout pour eux, ici-bas.

Là-haut, dans l'air qui s'obscurcissait toujours, une volée de corbeaux tournoyaient, jetant leurs croassements moqueurs au-dessus du plateau bondé de la chair des victimes de deux grandes batailles ; tandis qu'au loin, sur les remparts de la ville où l'artillerie se taisait, les vainqueurs, informés de la perte de nos navires, poussaient dans l'ombre montante des hurlements de triomphe. Vautours et corbeaux unissaient leurs voix discordantes avant de se ruer sur la dépouille des vaincus.

Les funérailles terminées, le sergent qui soutenait la veuve voulut l'arracher du bord de la fosse maintenant comblée, où la malheureuse semblait voir encore celui qui pour toujours dormait dans la terre des braves.

Mais elle résistait.

— Ma pauvre dame, vous ne pouvez pas rester ici, dit-il ; voici que la retraite a commencé.

Elle remua la tête, mais ne bougea point.

— Où demeurez-vous ?

— A l'Ange-Gardien, murmura-t-elle.

— Mais comment allez-vous faire pour y retourner ?

— Je ne sais pas, moi. Avant de me tuer mon mari et le père, ils avaient brûlé notre maison... Je n'ai plus rien au monde.

— Et votre enfant... ? dit la voix grave du prêtre.

— Ah ! c'est vrai ! s'exclama la mère en embrassant son fils.

— Sergent, dit l'aumônier, vous allez la conduire jusqu'aux première maisons de Sainte-Foye. Elle y trouvera bien un asile jusqu'à ce qu'elle puisse retourner vers ceux qui la connaissent.

Quelques instants plus tard, l'arrière-garde qui couvrait la retraite, tournait le dos à

la ville et s'engageait à son tour sur la route enténébrée de Sainte-Foye. Soutenue par son guide, la mère emportant son fils s'en allait avec eux.

Cette veuve de soldat qui portait cet orphelin dans ses bras, et qui, ployant sous le faix de la douleur et de la détresse complètes, s'enfonçait dans la nuit de l'inconnu, c'était l'image du Canada français vaincu par le nombre et la fatalité. A cette heure terrible, il semblait bien que c'en était fini de nous comme race. Et pourtant, merci à Dieu ! nous sommes la postérité, nombreuse et vivace, de cet orphelin français abandonné dans l'Amérique du Nord.

Au temps présent, où quelques énergumènes osent rêver tout haut de notre anéantissement, il est peut-être bon de rappeler ce que nous fûmes... et ce que nous sommes aujourd'hui.

XV — *L'Aigle et la Marmotte* — *Fable,*

Par F. G. MARCHAND.

(Lu le 28 mai 1885.)

Du haut d'un chêne vigoureux
L'Aigle, de son regard superbe,
Épiait, se glissant sur l'herbe,
Un être indolent et peureux.
Avec mépris il l'interpelle...
La Marmotte, car c'était elle,
Surprise, et trop lâche pour fuir,
S'écrase à l'instant contre terre,
Croyant que son heure dernière
Va venir.
— Hola! dit le roi de la nue,
De sa plus formidable voix,
Si méprisable que tu sois,
Je t'absoudrai d'être venue
Imprudemment
Exposer à mes yeux ta mine paresseuse,
Si tu me dis comment
Tu te complais dans cette vie oiseuse,
Et pourquoi, seule et sans amis,
Tu vis en ta tanière immonde,
Indifférente aux bruits du monde.
— Noble seigneur! répond d'un ton soumis
La Marmotte effrayée,
A deux objets ma vie est employée:
Dormir, manger, voilà les modestes plaisirs
Qui remplissent mes jours et comblent mes désirs.
Le reste ne m'est rien, et je suis bien payée
Du sacrifice que j'en fais
Quand on me laisse en paix.
— Ignoble créature!
Dit l'Aigle avec dédain;
Puis, déployant sa puissante envergure,
Rapide, il prend son vol vers le ciel... mais soudain
L'orage se déchaîne,
Et l'Aigle foudroyé tombe au pied du grand chêne;

Tandis qu'en son réduit,
Blottie avant l'orage,
La Marmotte sans bruit
S'applaudit d'être sage.

La Marmotte souvent porte des traits humains.
Que d'hommes bien repus, mais au moral des nains,
Qui n'ont pour tout souci que leur propre bien-être,
Chez qui nul sentiment généreux ne pénètre,
Et qui toujours battent des mains,
Quand le génie, — en ses élans sublimes,
Dépassant les plus hautes cimes
Pour atteindre aux confins de l'immense inconnu,
Et méprisant la vulgaire prudence, —
Tombe martyr de la science,
Par l'impossible retenu !

XVI — *A travers les registres,*

Par L'ABBÉ C. TANGUAY.

(Lu le 28 mai 1885.)

L'histoire de notre pays est aujourd'hui connue sous tous ses grands aspects. Les travaux de nos historiens nous ont fait saisir dans son ensemble l'œuvre des découvreurs du Canada, des fondateurs de la Nouvelle-France, les terribles luttes de tout genre endurées par nos ancêtres, leurs glorieux combats et les deuils de la patrie. Ces historiens ont poursuivi avec succès une œuvre qui restera et qui n'est pas à refaire.

Mais est-ce à dire que le champ de notre histoire est aujourd'hui fermé à toute investigation ? tout a-t-il été exploré ? Non certes ; il y a encore bien des côtés à étudier. Les grandes lignes sont clairement tracées, mais que de points encore à éclairer ; que de jugements basés sur des faits incomplètement connus à rectifier ; que d'explications à donner sur nos origines !

Modeste ouvrier dans cette grande entreprise de notre histoire nationale, j'ai souvent été surpris de voir surgir dans mes feuilles des faits qui jettent un jour nouveau sur des côtés obscurs de nos annales, ou qui complètent, sur certains faits, les récits de nos historiens.

Les registres que j'ai compulsés, d'une extrémité à l'autre de notre Nouvelle-France, ont été souvent pour moi une mine de renseignements précieux que j'ai soigneusement recueillis.

Pour donner une idée de ces découvertes qui aident à mieux comprendre notre histoire, j'en citerai ici quelques-unes :

On s'est souvent demandé, comme le savent les auditeurs distingués qui m'écoutent, si le recensement de 1666, — le premier qui ait été fait dans le pays, — avait été fait au commencement ou à la fin de cette même année, et si par conséquent il comprenait ou non les familles arrivées pendant l'été de 1666 ?

Les registres m'ont permis de prouver jusqu'à l'évidence que ce recensement ne donne que le dénombrement des familles arrivées avant la saison de l'été 1666, comme je vais le démontrer plus loin.

En 1687 un massacre avait eu lieu sur les bords du lac Saint-Louis, et les victimes de la cruauté iroquoise avaient été inhumées sur le lieu même. Tous les détails de noms, d'âge et de lieu se rattachant à ces infortunés sont consignés dans les registres de Lachine, en 1687. Inutile de les chercher ailleurs.

Ailleurs, j'ai trouvé la dernière des pages qui racontent le sanglant épisode des massacres de Lachine, en 1689. Quelques années après cette date tristement mémorable, c'est-à-dire en 1694, le curé de la paroisse des Anges de Lachine recueillait les restes d'un grand

nombre des victimes du massacre pour leur donner la sépulture religieuse avec les prières de l'Eglise.

— J'ai de même établi l'authenticité de lettres très-intéressantes et inédites au sujet du supplice du feu auquel furent condamnés en 1695, quatre Iroquois; et ce sont les registres de Ville-Marie qui m'ont fourni cette preuve d'authenticité.

— J'ai aussi constaté que le nom de *Kondiaronk-le-Rat*, ce chef sauvage que tous nos historiens ont célébré dans leurs écrits, n'est pas le véritable nom de ce héros si remarquable. L'acte de sa sépulture, qui doit certes être un document authentique, le désigne sous le nom de *Gaspard Soiaga-dit-le-Rat.*

Par l'étude des registres il m'a encore été possible de tracer l'origine du célèbre Dubocq, dont parle Charlevoix (livre XVI, p. 199) et qui fut fait prisonnier en 1697, près d'Orange, dans un combat contre les Mahingans et les Agniers; et dans la collection des lettres citées plus haut, j'ai pu recueillir l'histoire de l'horrible exploit (1703) qui lui valut la vie et la liberté.

— Les registres de l'année 1700 m'ont encore fourni des renseignements précieux, en donnant le moyen de déterminer, à quelques mois près, la date de la mort de Louis Joliet, le découvreur du Mississipi.

A part ces renseignements d'une si haute importance, les registres m'ont aussi donné l'origine des noms de certaines localités mentionnées dans l'histoire, ainsi que leur position géographique : comme la Pointe à Lacaille, aujourd'hui Saint-Thomas de Montmagny, le cap Lauzon, aujourd'hui Deschambault (1736), le cap à l'Arbre, aujourd'hui Saint-Jean-Deschaillons.

Toutes ces notes, je les ai consciencieusement recueillies à leurs véritables sources, et j'en ai formé la collection que je désignerai sous le titre de : *A travers les registres.*

Recensement de 1666.

Le premier recensement du Canada remonte à l'année 1666. Ne portant aucune date qui puisse constater s'il donne la population de 1666 seulement, ou cette population augmentée du chiffre des colons venus pendant la saison de l'été 1666, on se demande alors en quel mois de l'année il a eu lieu.

L'absence de statistiques antérieures semblait rendre difficile la solution de cette question ; et le regretté M. Lajoie, bibliothécaire du parlement, plusieurs fois m'avait exprimé son regret de ne pouvoir publier un recensement si précieux, parce que la date précise de son existence était ignorée.

Dès lors je me proposai d'en faire la recherche par l'étude des registres de l'état civil, et bientôt je m'assurai que le dénombrement comprenait la population de 1665, et non pas celle de 1666, et voici mon procédé : Prenant le tableau des familles entrées au recensement, je le comparai avec celui des familles portées sur les registres des paroisses. Et après avoir réuni les noms de quelques enfants dont l'âge respectif était au-dessous de six mois, je dressai le tableau suivant, lequel, mis en regard de la date de naissance des mêmes enfants, prouve à l'évidence que le recensement a eu lieu en février et mars 1666.

Je trouve au recensement que Marie-Madeleine, fille de Philippe Maton est âgée de 6 mois.
Le registre me donne le jour de sa naissance : elle est née le 5 juillet 1665.
Ignace, fils de Sébastien Liénau, 6 mois, est né le 16 avril 1665.
Madeleine, fille d'Etienne Sedilot, 6 mois, est née le 12 juin 1665.
Elizabeth, fille de Jean Leboux, 3 mois, est née le 12 octobre 1665.
Nicolas, fils de Guillaume Bonhomme, 3 mois, est né le 25 octobre 1665.
Marie-Barbe, fille de Joachim Girau, 15 jours, est née le 27 janvier 1666.

François, fils de René Emond, 12 jours, est né le 30 janvier 1666.

Marguerite, fille de Pierre Tremblay, 3 mois, est née le 4 octobre 1665.

Marie-Anne, fille de Jean Caron, est née le 11 novembre 1665.

Marie-Madeleine, fille de Paul Chalifoux, est née le 25 mars 1665.

Marie-Catherine, fille de Louis Artus, 6 mois, est née le 15 mai 1655.

Je constatai encore que les enfants, nés après mars 1666, ne se trouvaient pas entrés au recensement, comme :

Catherine, fille de Gabriel Celle-Duclos, née le 2 mai 1666.

Françoise, fille de Pierre Chamarre, née le 3 août 1666.

Catherine, fille d'André Charly, née le 3 juin 1666.

Pierre, fils de Guillaume Constantin, né le 21 avril 1666.

Et d'autres n'étaient pas encore nés lorsque les officiers chargés de ce travail firent le dénombrement de la population, en l'année dite 1666. J'en conclus, par cette preuve évidente, que ce recensement avait été fait en février et mars 1666.

Quelques victimes des Iroquois inhumées près des bords du lac Saint-Louis en 1687, retrouvées en 1866.

Des squelettes humains ayant été trouvés en 1866 par quelques cultivateurs propriétaires d'un terrain situé sur les bords du lac Saint-Louis, au haut de l'île de Montréal, information en fut immédiatement donnée au curé du lieu, M. l'abbé Chèvrefils, qui, de suite, voulut s'intéresser à faire toutes les recherches propres à découvrir les noms, les âges et l'époque de la sépulture des personnes dont on venait de retrouver les restes. Sur l'un des squelettes se trouvait un crucifix, qui par le travail du temps portait le cachet d'une longue existence. [1]

Cet objet religieux prouvait que les restes déposés en ce lieu étaient évidemment ceux de quelques chrétiens.

M. le curé Chèvrefils, après avoir consulté les archives de la paroisse de Sainte-Anne du bout de l'île de Montréal, ne put y découvrir aucun document qui retraçat l'existence soit d'une chapelle, soit d'un cimetière, en ce lieu appelé *la baie d'Urfé*. Les registres de l'Etat civil, ouverts en 1704, étaient aussi muets sur les noms et l'âge de ces dix personnes dont les corps reposaient en ce lieu.

Cet estimable confrère m'écrivit alors, espérant que mes nombreuses recherches statistiques et mes études généalogiques *à travers les registres* pourraient peut-être me permettre de résoudre le problème intéressant qu'il me proposait. Ses espérances ne furent point déçues, et j'eus la vive satisfaction de l'informer que j'avais en mains les documents complets qu'il désirait connaître. Les dix personnes inhumées en ce lieu étaient des Français, massacrés en 1687 par les Iroquois, et qu'un prêtre missionnaire, M. l'abbé d'Urfé, sulpicien, "avait inhumé proche le lieu destiné pour bâtir l'église de Saint-Louis du haut de l'Ile de Montréal." [2]

Ayant reçu cette information, le curé de Sainte-Anne recommanda, le dimanche suivant, aux prières de ses paroissiens les défunts, donnant les noms, les âges et même la date de la sépulture de chacun d'eux; et leurs cendres, enfermées dans une même tombe, furent transportées dans l'église de Sainte-Anne, où, après un service solennel, elles reçurent de nouveau la sépulture ecclésiastique, en présence de tous les paroissiens qui comptaient des ancêtres parmi les infortunées victimes. C'est dans les registres de Lachine, année 1687, que j'ai trouvé les actes de sépulture de ces victimes dont suivent les noms, savoir :

Claude de la Mothe, âgé de 40 ans. [3]

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[1] M. l'abbé Chèvrefils conserve précieusement cette relique.

[2] La paroisse actuelle de Sainte-Anne du bout de l'île devait donc, en 1687, être sous le vocable de *Saint-Louis*, ce qui est assez naturel, vu qu'elle se trouve sur les bords du lac qui porte ce nom.

[3] Dit le marquis des Jourdis, natif de Saint-Leu, diocèse d'Arras, époux de Françoise Sabourin.

J.-Bte LeSueur, âgé de 21 ans. [1]
Louis Jets, âgé de 24 ans. [2]
Jean Vincent, âgé de 45 ans. [3]
Jean Delalonde, âgé de 47 ans. [4]
Pierre Bourceau, âgé de 38 ans. [5]
Pierre Perthuis, âgé de 24 ans. [6]
Henri Fromageau, âgé de 25 ans. [7]
Pierre Petiteau, âgé de 20 ans. [8]
Pierre Carmes, âgé de 21 ans. [9]

Une dernière page du sanglant épisode des massacres de Lachine.

Un document consigné dans les registres de Lachine, à la date du 28 octobre 1694, se lit comme suit :

" Ce jourd'hui, vingt-huit octobre 1694, fête de saint Simon et saint Jude, en vertu de certain mandement de Mgr l'Illust. Révérendiss : Evêque de Québec, en date du 18 juin dernier, signé *Jean*, Evêque de Québec, contresigné par son secrétaire Trouvé et scellé du sceau de ses armes, suivant les publications et annonces que nous avons faites aux prônes par deux dimanches consécutifs, nous Pierre Rémy, curé de la paroisse des Saints Anges de la Chine, en l'Ile de Montréal, nous sommes transportés, à l'issue de la messe de paroisse, aux lieux où avaient été enterrés les corps de plusieurs habitans de cette paroisse, tant hommes que garçons, femmes et filles, le 5 août 1689, que les castes, maisons et granges de cette paroisse furent prises, saccagées et brûlées par les Iroquois, pour les inhumer et transporter dans le cimetière, ce qui n'avait pu être fait plus tôt, tant par les incursions des Iroquois qui ont été fréquentes depuis ce temps, que parce que leurs chairs n'étaient pas encore consommées, et pour les transporter et les enterrer dans le cimetière de cette paroisse, ce que nous avons exécuté en la présence de plusieurs de nos paroissiens :

" 1o Près la maison de Lalonde était le corps de Jean Fagueret dit Petitbois, où ayant fait des fouilles avec des pioches, proche une grosse roche nous avons trouvé tous ses os, toutes les chairs étant consommées, — lesquels nous avons fait lever de la terre.

" 2o Sur l'habitation de feu Jean Michau [10] nous avons trouvé les os dudit Jean Michau et de son fils Pierre, âgé de 15 ans, et d'Albert Boutin, de 18 ans, [11] fils de sa femme.

" 3o Sur l'habitation de feu Noël Charmois dit Duplessis, [12] nous avons trouvé les os dudit Charmois, d'André Danis dit Larpenty, tués et brûlés.

" 4o Sur l'habitation d'André Rapin, nous avons trouvé dans un creux, cinq têtes, dont une de Perinne Filastreau, [13] femme de Simon Davaux dit Bouterain, avec ses os, une tête et les os d'un garçon qu'on dit être un soldat ; deux têtes d'enfants et leurs os, et la tête de Marie Cadieu, femme d'André Canaple dit Valtagagne, [14] dont les os furent trouvés dans une fosse, au pied du grand bastion du fort Rolland.

" Nous avons fait aussi lever de terre, sur le bord de l'eau, une partie des os de deux soldats, tués le 6 août 1689, dans le combat que les Iroquois livrèrent aux Français entre le fort de l'église et le fort Rolland ; n'ayant pu faire inhumer le reste des os, à cause du débordement des eaux qu'il fait à présent.

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[1] Natif de Pont-L'Evèque, diocèse de Lizieux.
[2] Natif de Courson, pays d'Aunis, meunier.
[3] Natif de Conflans, diocèse de Limoges, trouvé meurtri de coups par les Iroquois.
[4] Dit L'espérance, du Hâvre-de-Grâce, diocèse de Rouen, époux de Marie Barbary.
[5] Dit Lajeunesse, caporal de milice de la ville de Tours, diocèse de Poitiers, époux de Marie-Madeleine Gignard
[6] Natif d'Amboise, diocèse de Tours.
[7] Natif de LaRochelle, en Aunis.
[8] Natif de Saint-Macaire, Bretagne.
[9] Dit Lafeuillade, natif de Montesson, soldat de M. de Cruzel.
[10] Son véritable nom est Michel, époux de Marie Marchesseau, veuve de Pierre Boutin.
[11] C'est une erreur, Albert Boutin avait 24 ans, étant né le 7 septembre 1670.
[12] C'était un vieillard de 69 ans.
[13] Fille de René Filastreau, née en 1663, et mariée en 1677.
[14] Tonnelier, marié depuis un an seulement avant le massacre. — L'Auteur.

"5o Nous avons envoyé six hommes par delà de la petite rivière de la Présentation, sur l'habitation de feu René Chartier,[1] où lui et ses deux fils,[2] et un petit sauvage, leur esclave, de la nation des Panis, avaient été tués par les Iroquois, le 5 août 1689, et où plusieurs personnes nous ont, depuis leur mort, rapporté avoir vu, sur la terre, leurs têtes et leurs os; mais les herbes ayant crû depuis ce temps, ils n'ont pu en rien trouver,[3] et le soleil étant prêt de se coucher, nous nous sommes retirés, ayant fait mettre ces os dans un bateau que nous avons été recevoir, avec le surplis et l'étolle noire, au son de la grosse cloche, accompagné d'acolytes en surplis, portant les chandeliers, la croix et l'eau bénite, et chantant les psaumes, suivant la coutume de la sainte Eglise; et les ayant fait couvrir du drap mortuaire, nous les avons fait porter et mettre en dépôt en l'église pour en faire, le lendemain, l'inhumation dans le cimetière: ce que nous fîmes avec grande solennité, après avoir dit, dessus les os, une grande messe de leur anniversaire, et fait tout le service avec offrande de pain et de vin. Et de ce que dessus, avons fait et dressé présent procès-verbal pour servir et valoir en temps et lieu, que nous avons signé et fait signer par André Rapin et Jean Paré, anciens marguilliers, et Guillaume D'Aoust, chantre de cette église.

Suivent les signatures; — "André Rapin, Jean Paré, Guill. D'Aoust et P. Remy, curé."

"A l'égard des corps de Vincent Alix dit Larosée, de Marie Perrin, sa femme et une partie de leurs enfants que les Iroquois brûlèrent dans leur maison, le 5 août 1689, on n'y a rien trouvé, le feu ayant consumé les chairs et les os."

Madeleine Boursier, enfant de onze mois, fut aussi tuée et noyée, le 5 août 1689, par les Iroquois, et ses os furent inhumés le 31 octobre 1694.

Quatre Iroquois condamnés au feu.

Toute la population de Montréal est présente au supplice du feu, auquel sont condamnés quatre Iroquois, qui ont reçu le baptême quelques instants auparavant. *Registres de Montréal*, 7 *avril* 1695.

Dans la collection des lettres inédites de 1701, que j'ai parcourues, je trouve le récit de ce supplice terrible, ainsi rapporté:

........"Au moment où j'arrivais à Montréal pour la première fois, ce fut par la porte Saint-François. J'y aperçus un homme de mon pays qui venait au-devant de moy pour m'embrasser, ce qu'il fit, et, après quelques compliments, il m'apprit qu'il était de notre compagnie.

"Comme nous étions à parler ensemble, il s'aperçut que j'étais fort distrait à cause d'une grande populace que je voyais dans la place des jésuites. Là-dessus mon nouveau camarade me dit: Ma foy, vous arrivez bien à propos pour voir brusler quatre Iroquois vifs; avançons, continua-t-il, jusqu'aux jésuites, nous verrons mieux. C'était aussi devant leur porte où devait se passer cette sanglante tragédie. Je m'imaginay d'abord qu'on allait jeter ces misérables dans le feu; mais regardant de tous côtés, je n'apercevais aucun bûcher pour le sacrifice de ces victimes; j'interrompis ce nouvel amy au sujet de plusieurs petits feux que je voyais en de certaines distances les uns des autres; il me répondit: Patience nous allons bien rire. Il n'y avait cependant pas à rire pour tout le monde. On amena ces quatre hommes sauvages, qui étaient frères, et les plus beaux hommes que j'aye vus de ma vie, ensuite les jésuites les baptizèrent et leur firent quelques légères exhortations, car à parler franchement, de plus, ce serait laver la teste d'un mort, cette sainte cérémonie étant finie, on les prit et on les sacrifia à des supplices dont ils sont les inventeurs. On les lia tout nuds à des poteaux enfoncés de trois à quatre pieds en terre, et là, chacun de nos sauvages alliés, ainsi que plusieurs Français s'armèrent de morceaux de fer rouge avec lesquels ils leur grillèrent toutes les parties du corps. Ces petits feux que j'avais

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[1] Il avait 76 ans lorsqu'il fut tué; il était marié à Marguerite Delorme.

[2] L'aîné appelé Francois, avait 16 ans; l'autre, dont le nom n'est pas donné, pouvait avoir 15 ans.

Le 23 mai 1704, nous avons enterré dans cette église une partie des os de feu René Chartier, que nous avions fait lever sur son habitation. — P. Rémy, curé.

vus servaient de forges pour faire rougir ces abominables instruments avec quoy on les faisait rôtir. Leur supplice dura six heures, pendant lesquelles, ils ne cessèrent de chanter des exploits de guerre, en buvant de l'eau-de-vie qui passait dans leurs corps aussy vite que si on l'eût jettée dans un trou fait en terre. Ainsi finirent ces malheureux, avec une constance et un courage inexprimable. On m'assura que ce que je voyais n'estait qu'un faible échantillon de ce qu'ils nous font souffrir, quand ils nous ont faits prisonniers."[1]

D***

KONDIARONK

Kondiaronk est bien le nom sous lequel nos historiens distinguent ce chef célèbre. Cependant si l'on consulte l'acte de sa sépulture consignée dans les registres de Montréal, nous trouverons que son véritable nom est *Gaspard Soiaga-dit-LeRat*. Il était chef des Hurons de Michillimackinac, et à son décès il était âgé de soixante-quinze ans.

L'abbé Ferland s'exprime ainsi :

"En ce jour, 3 août 1701, a lieu dans l'église de Montréal, la sépulture du chef des Hurons que nos historiens ont appelé Kondiaronk. Ce chef est une des plus belles figures de la nation huronne. Doué d'une haute intelligence, il conduisait avec prudence et sagesse toutes les affaires de la nation.

Il mourut dans des sentiments très chrétiens, après une harangue qu'il avait prononcée dans une assemblée des nations alliées, réunies à Montréal.

Sur sa tombe on grava cette courte inscription : "*Cy-gît LeRat, chef huron.*"[2]

DUBOCQ

[3] Un Français, Laurent Dubocq, natif de Saint-Maclou, diocèse de Rouen, Normandie, avait épousé, à Québec, en 1662, Marie-Felix, huronne, fille de Joachim Arontio, de la bourgade de la Conception, et premier chef huron fait chrétien par le P. de Brébeuf.

De ce mariage naquirent quatre garçons[4] et deux filles. L'une, Marie-Anne, devint religieuse ursuline, dite Sainte-Marie-Madeleine ; l'autre Louise-Catherine, mariée à Jean Riddé, compte parmi ses descendants les familles Viger de Montréal.

C'est très probablement le fils de Joseph Dubocq, métis, marié à une française, qui est le héros de ce drame épouvantable que je vais rapporter.

Je cite la collection des lettres inédites. — Lettre 35e, vol. I, p. 206.

"Il arriva à Montréal, peu de jours après mon arrivée, un homme dont l'histoire paraîtra plutôt de la fable que de la vérité. On le nomme Dubocq.[5] Il est fils d'un sauvage et d'une Française. C'est un guerrier d'un grand courage et d'une force extraordinaire, qui a toujours été redouté comme le plus fier partisan du pays. Il avait été pris prisonnier par les Iroquois depuis un certain temps, et il attendait toujours le moment fatal où il devait estre brulé vif. Comme il se trouva un jour à la chasse en la compagnie de huit guerriers et deux femmes, qui lui firent feste qu'ils devaient cabaner en un endroit où il y avait une bonne cache d'eau-de-vie. En effet ils arrivèrent à ce précieux dépôt, comme ils l'en avaient assuré ; mais ces pauvres sauvages ne scavaient pas que cette feste donnerait lieu à une sanglante expédition. Ayant donc bien soupé tous ensemble, ils se mirent à chanter et à

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[1] Ce supplice eut lieu le 7 avril 1696.

[2] Ferland, tome II, p. 35.

[3] Note de l'auteur.

[4] Joseph, Jean, Laurent, Philippe.

[5] Petit-fils de Laurent Dubocq, qui avait épousé en 1662 Marie Arontio, huronne, fille du premier chef baptisé par le P. Brébeuf.

[6] Charlevoix, liv. XVI, p. 199.

1691 — Dubocq, dans un combat contre les Malhingans et Agniers, tomba dans une ambuscade près d'Orange. De seize combattants, dix furent tués. Dubocq et trois autres, blessés et conduits à Orange.

boire à leur ordinaire, qui est d'avaler l'eau-de-vie plus facilement que nous ne faisons le vin, dans nos plus grandes parties de plaisir. Ils invitèrent le prisonnier à les imiter dans leur débauche. Dubocq leur marqua sa reconnaissance en buvant quelques coups de la liqueur qui leur coûta bien cher : ce fut là qu'ils le regardaient comme une victime preste d'être immolée à la rage qu'ils portent à leurs ennemis, ce fut, au contraire, luy-même qui se proposa de les occir ou de périr à la peine, ce qui lui était inévitable ; mais en ce moment, étant tous camarades de plaisirs, ils chantaient des chansons sur les victoires qu'ils avaient remportées sur leurs ennemis et s'en donnaient à cœur joie ; car ces peuples ont cela de bon qu'ils sont tout au divertissement quand ils le prennent, et en récompense, plus sobres que tout le reste des hommes, quand il est question de guerre ou de chasse ; cette cachette d'eau-de-vie en est la preuve, puisqu'ils ne la visitaient qu'au retour de deux expéditions militaires, où ils avaient fait des merveilles. Ces infidèles gardent pour loy inviolable, de serrer ainsi leurs boissons et autres vivres quand il est nécessaire, ne portant autre chose que leur fusil, hache, couteau, casse-tête, poudre et plomb, avec leurs carcois garni de flèches, aymant mieux jeûner sept ou huit jours ou plus, s'il le faut, que de porter la moindre chose qui pourrait leur estre contraire, ou leur porter le moindre préjudice. Quand ils eurent la teste bien échauffée de cette boisson, et des chansons de prouesses de guerre, où ils dénombrent les guerriers qu'ils avaient tués ou brulés, quelques-uns d'eux commençaient desjà à se livrer dans les bras du sommeil pendant que ceux qui soutenaient mieux la gageure, forçaient toujours Dubocq à boire ; mais par malheur pour eux, n'ayant jamais eu l'usage de la chandelle, ils n'avaient point d'autre clarté dans leur cabane que celle que le feu leur procurait. Ainsi, ils ne purent pas s'apercevoir que Dubocq, quoyque fort enclin à boire, n'avalait pas l'eau-de-vie et qu'après l'avoir porté à sa bouche qu'il la laissait couler le long de son estomac. Ainsi, par ce moyen, il resta de sang-froid pendant que les autres s'enyvraient parfaitement, de sorte que, vers la moitié de la nuit, il n'y avait plus qu'un de ces guerriers qui ne dormait pas, et qui buvait tout seul ; mais l'instant d'après il fut pris comme les autres.

" Pourras-tu croire ce que fit Dubocq ?

" Après s'être bien assuré que ces dix personnes dormaient véritablement, il tint un conseil secret avec luy-même pour résoudre s'il profiterait de sa liberté, en se sauvant simplement, ou bien si il envoyerait ces gens-là au pays des asmes. C'est ainsi qu'ils parlent : Enfin il se détermina à cette dernière résolution néanmoins, en donnant la vie aux deux femmes, comme par une espèce de mépris en les regardant indignes de sa colère.

" Il commença par les attacher toutes deux ensemble, prévenu qu'il estait, qu'ayant la teste plus petite que les hommes, qu'elles devaient estre bien ivres, et plus difficiles à réveiller. Il les lia donc ainsi, ensuite il prit en mains deux gros tisons enflammés, avec lesquels il regarda la contenance de ces gens-là, et ne doutant plus de leur sommeil, il s'arma d'une forte hache, avec laquelle il les salua chacun, les uns après les autres, d'un grand coup sur la teste, et cela d'une vitesse extraordinaire, de façon que celui qui remuait le premier était servy de deux ou trois coups de hache qui le mettaient à mort, il acheva ainsi cette boucherie, et l'expédition entièrement finie, il voulut réveiller les deux femmes, toutefois, sans leur faire aucun mal ; mais il ne put jamais y parvenir. Ainsi étant lassé de les tourmenter, il prit le parti de passer la nuit à fumer sa pipe à la vue d'un si horrible spectacle.

" Le lendemain matin, au réveil de ces deux dames sauvagesses, il ne manqua pas de leur faire apercevoir qu'elles estaient veuves, et devenues ses esclaves, et enfin qu'il leur accordait la vie, à condition qu'elles porteraient témoignage à la vérité : Conditions qu'elles accordèrent avec toute la résignation possible ; mais au surplus, elles scavaient bien que cette scène sanglante, n'estait pas encore finie, et qu'il y manquait la dernière couche du portrait de l'humanité. Il est bon, mon cher frère, que tu apprennes que, quand ces gens-là ont tué quelqu'un sur la place, ils en apportent toujours la preuve, qui est selon eux, un trophée qui prouve au juste leur valeur et leur courage ; cette indigne marque est la chevelure humaine, qu'ils enlèvent aussi facilement de dessus la teste d'un mortel, qu'on peut faire la peau d'un lapin. Ils coupent la peau de la teste jusqu'à l'os en commençant au milieu du front, en tournant la main par derrière l'oreille, en suivant de mesme jusqu'à l'endroit où ils ont com-

mencé, et après quelqu'effort de main pour commencer à découvrir le crâne, ils posent la teste à la renverse sur leurs genoux, et sans quitter cette peau, elle vient aussi facilement qu'un gand qu'on veut tirer de la main, après quoy, ils la cousent autour d'un petit cercle d'ozier, la préparent et la passent du costé où il n'y a point de cheveux, tout aussi facilement qu'ils font une autre peau de quelqu'animal, et pour finir cet horrible chef-d'œuvre de cruauté, ils les peignent ensuite avec du vermillon, et les ayant attachées à des cercles d'ozier comme je viens de le dire, ils les mettent au bout d'une grande baguette de dix à douze pieds de haut. Pour en revenir à notre vainqueur, après qu'il eut employé le temps qu'il fallait à tout cela, il prit d'une main ces chevelures, et de l'autre les deux femmes liées ensemble, qui ne se faisaient pas prier de marcher ; il les mena ainsi jusqu'aux portes de Montréal, où s'étant arrêté suivant l'usage ordinaire, il fit des cris de mort au nombre de huit, pour faire voir qu'il avait occi huit hommes, suivant la preuve qu'il en avait en main.

" A ces cris, chacun s'empressa de courir au-devant de luy, croyant qu'il y avait beaucoup de guerriers qui arrivaient.

" En quoy l'on fut bien surpris et trompé quand on vit Dubocq seul. Je ne fus pas un des derniers à aller à sa rencontre, et comme je le connaissais particulièrement, je l'aborday avec une joye extrême en luy marquant, avec étonnement la part que je prenais à sa victoire, et au bonheur qu'il avait eu de se sauver d'avec les plus cruels hommes du monde, de qui il ne pouvait attendre que des tourments inouïs ; je ne le quittay point jusques chez le gouverneur, où il entra avec un air majestueux, tenant d'une main huit grandes baguettes au bout desquelles pendaient huit longues chevelures, et de l'autre ses deux prisonnières qu'il faisait marcher devant, attachées comme des enfants que l'on mène par la lizière.

" Monsieur de Callières le reçut fort favorablement, et écouta son récit avec autant d'admiration que d'étonnement, d'autant qu'il le fit en français fort éloquemment pour un homme demy sauvage, et dans les termes les plus naturels qui se puissent exprimer. Ensuite il fut recevoir deux cent quarante livres, en marchandises, qui est à raison de trente livres que l'on paye ordinairement pour chaque chevelure que nos sauvages apportent.

" Je t'embrasse avec la plus pure amitié qu'on puisse porter à un bon frère comme toy."

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Louis Joliet.

Preuves qui fixent l'époque de la mort de Joliet entre les mois de mai et octobre 1700.

Les registres de Notre-Dame de Québec mentionnent à la date du 4 mai le mariage de Jérôme Corda époux d'Anne Normand, à Québec. Parmi les témoins qui ont signé l'acte de mariage on trouve Louis Joliet, hydrographe du Roy — le découvreur du Mississipi. C'est très probablement le dernier acte qui porte sa signature, et qui, avec la lettre de l'Intendant, en octobre 1700, ont permis de fixer l'époque de la mort de Joliet entre mai et octobre 1700.

ROYAL SOCIETY OF CANADA.

TRANSACTIONS

SECTION II.

ENGLISH LITERATURE, HISTORY, ARCHÆOLOGY, ETC.

PAPERS FOR 1885.

I.—*The Half-Breed.*

By JOHN READE.

(Presented May 28, 1885.)

The opinion prevails that the fusion of white with Indian blood is of rare occurrence north of the Gulf of Mexico. There is, however, reason to believe that, both in Canada and the United States, it has been much more common than is generally assumed. In Mexico, the West Indies, Central and South America, pure blood is the exception, mixed blood the rule. Nor is it the aborigines alone that in this hemisphere have given rise, through their intercourse with Europeans, to new racial varieties. The negro has contributed largely to the same result, and the Chinese are also beginning to have an appreciable influence on the population of parts of the New World. In different regions of the Old World an analogous process is going on. Asia, Africa and the island domain of the Indian and Pacific Oceans furnish many instances of race amalgamation. Wherever we turn, indeed, we find that, in one shape or another, the inhabitants of the earth are, slowly in some places, with surprising rapidity in others, undergoing transformation by interfusion of blood.

The fact is not a novelty in human history. As far back as our knowledge of mankind can reach, with the evidences of race diversity we discover the indications of race intermixture. On the almost universally accepted theory of the unity of the human species, those divergences of feature and complexion which distinguish race from race must have required many ages to bring about. How they were caused we can only conjecture; but we know that four thousand years ago the negro was as much a negro as he is to-day. Of the neighbours of the Egyptians when their earliest monuments were constructed, Dr. Birch writes: "South of Syene lay the numerous black tribes, the so-called *Nahsi* or negroes, inferior in civilization, but turbulent and impatient of subjection. The skirts of the desert were held by wandering tribes called *Satu*, not yet subjected to the arms and discipline of Egypt. The western frontier was menaced by the *Tahennu* or Libyans. Beyond the north-east desert in which resided the *Herusha*, or inhabitants of the Waste, were the *Menat*, perhaps also a shepherd race, the dwellers of northern Asia; and hazily in the distance were seen the nascent forms of the empires of Babylon and Assyria, and the slowly rising power of the Phœnician States and Kingdoms."[1] Champollion-Figeac, citing the authority of his more illustrious brother, is still more explicit in his account of the nations known to the Egyptians, which he illustrates by six figures copied from the tombs of the Kings at Biban-el-Molouk.[2] These leave no doubt that the Egyptians

[1] Egypt from the Earliest Times to B.C. 300, by S. Birch, Introd. p. ix.

[2] Égypte Ancienne, p. 30.

of the Nineteenth Dynasty were acquainted with the main race divisions—black, red, brown, yellow and white—with which we are familiar in our own generation. When, however, we contemplate the gulf that separates the Caucasian from the negro, we must conclude that, compared with the duration of man's life on earth, that remote period is but as yesterday.[1]

From what order of primitive men did the various races descend? One distinguished geologist maintains that there is "no ground for the belief in the existence, even in the most ancient times, of any race of men more rude than the modern semi-civilized races or less developed physically."[2] This view, of course, the evolutionist cannot hold. His theory necessitates a transitional stage from the infra-human to the human, and the beings in whom the high characteristics of humanity would be first dimly recognizable were probably of the type that would suggest what the witty poet called the "prentice hand" of Nature. Prof. Grant Allen has drawn for us a picture of a "tall and hairy creature, more or less erect, but with a slouching gait, black-faced and whiskered, with prominent prognathous muzzle and large prominent, canine teeth;" whose "forehead was, no doubt, low and retreating, with bony bosses underlying the shaggy eye-brows, which gave him a fierce expression, something like that of a gorilla."[3] That such a creature existed Mr. Allen, considers an "inevitable corollary from the general principles of evolution." What such a primitive being would look like may be imagined from Mr. Cushing's ideal representation of the Neanderthal man, which forms the frontispiece to Mr. J. P. McLean's "Manual of the Antiquity of Man." Whether they paint his portrait or leave his lineaments to conjecture, all writers of the development school and some who do not belong to it select, as the Adam of their *Sepher Toldoth*, a type compared with which no savage of the present could be regarded as degenerate. Professor Winchell, referring to what, until not very long ago, was considered the orthodox view of the first man, writes as follows: "Those who hold that the white race, the consummate flower of the tree, has served as the root from which all inferior races have ramified, may select their own method of rearing a tree with its roots in the air and its blossoms in the ground. I shall put the tree in its normal position.[4] Fixing upon the Australians as the lowest extant type of humanity, he gives the Pre-Australian the second place in his affiliated classification of mankind, taking as its cradle a hypothetical continent in the Indian Ocean, of which the Malagasy Archipelago is the visible remnant. From this central "Lemuria," as it has been named (but which Mr. A. R. Wallace claims to have proved utopian[5]), Professor Winchell attempts

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[1] In a useful little work, called the Development Theory, by Joseph and Mary Bergen, an attempt is made, by means of a diagram, to convey a notion of the possible antiquity of mankind. A diminutive square represents the time from the earliest historical period to the present; a larger square, the time since the close of the last glacial period; a still larger square, the time since the beginning of the penultimate glacial period; and, finally, a very much larger square, the time since the beginning of the Tertiary. The question is one, it need hardly be said, on which much difference of opinion exists. While some demand millions of years for the development of primitive man into the man of the river-drift, others are satisfied with from eight to ten thousand years for the whole period of man's life on earth. Sir William Dawson, for instance, writes (Fossil Men, p. 246): "What evidence the future may bring forth I do not know, but that available at present points to the appearance of man, with all his powers and properties, in the Post-glacial age of Geology, and not more than from 6,000 to 8,000 years ago."

[2] Fossil Men, etc., by Sir J. W. Dawson, p. 249.

[3] "Who was Primitive Man?" in Fortnightly Review, and Popular Science Monthly, Nov., 1882.

[4] Preadamites, p. 297.

[5] Island Life, p. 371.

to trace the slow progress of racial divergence and dispersion into the regions of the earth now inhabited by man. If his genealogy and chart of dispersion are, as all such undertakings must be, largely made up of conjecture, his scheme is, in its main features, rational and fruitfully suggestive. If he has not discovered the very truth as to the development of the human races, he has, at least, indicated the path that may lead to the desired goal. We are not bound to accept Lemuria, nor to believe that the monuments of the first men, if they left any behind them, lie at the bottom of the Indian Ocean. Neither need we regard with equal favour all the details of his genealogies. But his classification and plan of distribution may be adopted, with necessary modifications as fresh light is shed on the subject, no matter where we fix our central starting-point. M. de Quatrefages, for instance, locates the first members of the family of mankind in the vast plateau bounded on the south and south-west by the Himalayas, on the west by the Bolor Mountains, on the north-west by the Ala-Tau, on the north by the Altai range and its offshoots, on the east by the King-Khan, on the south and south-east by the Felina and Kuen-lun; around that region he finds grouped the fundamental types of all the human races, the black races being the farthest from it. No other part of the globe, M. de Quatrefages urges, presents such a union of extreme human types distributed around a common centre, and, after stating some objections to his view, he concludes that no facts have yet come to light which authorize the placing of the cradle of mankind elsewhere than in Asia.[1] If, however, as M. de Quatrefages himself is inclined to believe, Abbé Bourgeois has proved the existence of Tertiary man, it is absolutely vain to look for any certainty as to his primal abode. One thing we may take for granted—that, wherever man originated, he must soon have spread out in various directions; and thus, step by step, the different zones were occupied and the process of differentiation went on, climate and the other manifold environments exerting their natural influence. In an article contributed to *Nature* (November 6th, 1884), Mr. A. F. Fraser states that wherever the sun is hottest all the year round, "the blacker are the natives down to the equator of heat." The line in question, as traced by the late Dr. Draper, enters Africa along the coast of the Gulf of Guinea; then, rising to about 15°, it crosses the continent, escaping from the eastern promontory at Cape Guardafui; it intersects the most southerly portion of Hindostan; then crossing the earth's equator, it passes through the midst of the Eastern Archipelago, and returning through America traverses this continent at its narrowest point, the Isthmus of Panama. The recession of the Mediterranean from the Desert of Sahara, in the opinion of the same philosophic writer, and its contraction within its present limits, had doubtless much to do with the possibility of negro life.[2] On the other hand, he maintains that the conditions for its production did not exist in America. For, whereas the range of equatorial warmth in Africa is 4,000 miles, in Central America it is only fifty-one. It may also be that equatorial America has been occupied for a period too short to dye the skin of the natives as that of the Central African has been dyed. At any rate, we know that, though the negro lives with comfort in intertropical America, as though it were his native habitat, he is merely an importation to its shores, where most likely he would never have landed had not his white master brought him thither by force. But even those who insist that nearness to the heat of the equator has been the main cause of the negro's blackness have to concede the dark-skinned tendency in races situated towards the Pole.

[1] The Human Species, p. 175.

[2] History of the American War, i. 122.

Whatever were the reasons for the differentiation, it is known, as already pointed out, that between B.C. 3000 and B.C. 2000, the black, brown, yellow, red and white races, had assumed the characteristics by which they are still distinguished. And who can tell by what breaking-up and regrouping, often repeated, that stage was finally attained? All kinds of investigation have been brought to bear on the early movements of our race over the surface of the earth. The spade of the archæologist has raised to the light of day invaluable treasures of knowledge regarding a past of which the world hardly dreamed. Beneath the historic fields of Europe there lay for ages, awaiting the seeing eye and the understanding brain of the Nineteenth Century scientist, the monuments of races compared with which the great civilizations of the historic past may be considered modern. Nor is it in Europe alone that these relics of forgotten peoples have rewarded the zeal of the searcher. Already science has begun to gather from beneath the soil of China the evidences of occupation by rude tribes whose presence long antedated the earliest of its historic races. According to Pauthier,[1] when the founders of Chinese civilization first arrived in the country, they, like the early settlers in the New World, encountered the primeval forest, peopled only by tribes of savages with which they had frequently to wage war. In the mountains and otherwise inaccessible parts of the empire, still linger the descendants of such of those aborigines as escaped extermination or absorption at the hands of the conquerors. Some of them, it is said, have maintained their wild independence and isolation for 5,000 years. But those wild men of the woods were not the only people with whom the in-coming Chinese came in contact. They are but one of several races that looked upon the region as their possession by right divine. S. Wells Williams, who spent many years among the Chinese, ascribed to the Middle Kingdom a diversity of race which places it on a par with the most mixed of western nations. Besides the *Miautsze* or "children of the soil," the *Mongol* and *Manchu*, and their many varieties, there are almost countless types scattered through the empire, some of them in the maritime regions, others hidden away in the far interior where travellers seldom reach them. Such names as "Mongol" and "Tatar" (commonly called "Tartar") are entirely misleading, when regarded, as they often are, as implying a common origin. When Genghis rose to power, Williams tells us, he called his own tribe *Kukai Mongol* meaning "celestial people," designating the other tribes *Tatars* or "tributaries."[2]

Besides the "children of the soil," there are other relics of the occupants, in early times, of both mainland and islands. Lieut.-Col. Chas. Hamilton Smith says that in the northern mountains there are tribes of men over six feet high.[3] There is also an aboriginal race in the centre of the Island of Hainan, and many other instances might be mentioned. Enough has, however, been adduced to show that, even those races that seem most uniform in their type are really made up of repeated interblendings with other families of mankind. The little communities that, in their seclusion, preserve the features of the primitive possessors of the land, thus render an important service to science, though they, too, have probably in their veins some share of the blood of the victorious intruders.

If the Chinese, whom Prof. Winchell pronounces "the most homogeneous family of mankind," can be shown to be of mixed origin, we have less difficulty in assigning such

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[1] Chine Ancienne, p. 56.

[2] The Middle Kingdom, i. 165.

[3] Natural History of the Human Species, p. 185.

a derivation to most other Asiatic races. The Japanese, who bear physically a close resemblance to their continental neighbours, doubtless mingled to some extent with the aboriginal Aınos, whom they dispossessed. The terms "Malayo-Chinese" and "Indo-China" speak for themselves. "Malaysia," says de Quatrefages, "presents a perfect mixture of most different races from the white to the negro."[1] Winchell supposes the original Malay centre to have been "the peninsula on the south-east of Asia, or the islands contiguous, or perhaps, a continental region which has been reduced by geological denudation to some insular relics of itself." This certainly leaves us an amplitude of choice, but the fact is that the Malays have spread so far and wide from their primal home and have blended their blood with so many races, that it is impossible to ascertain where they first appeared. We find their characteristics in greater or less strength from Madagascar to the Sandwich Islands. The Polynesians diverge farthest from the Mongolian type, while the sub-race of the Micronesians fades, in one direction into well marked Malays, and in the other, into the Papuan type.[2]

The ethnology of India presents abundant evidence of miscegenation since the earliest times. The earliest page of its history discloses, Dr. Hunter tells us, two races struggling for the mastery—one, the fair-skinned Aryans from Central Asia, the most eastern representatives of the great Indo-European stock; the other, of lower type, long in possession of the country, and which the new-comers stigmatized in turn as non-Aryans, enemies, and slaves of black descent. These primitive predecessors of the Aryans had no records, and their traditions do not tell us much, but such hints as they yield point northward.[3] Their language indicates that the early peoples of India belonged to three great families—the Tibeto-Burman and the Kolarian, who entered Bengal from the north-east, and the Dravidian, who, coming from the north-west, rushed forth in a mighty mass which no foes could resist, and spread themselves over the south of the peninsula. How manifold was the composition of the non-Aryan inhabitants of India may be gathered from the fact that their principal languages and dialects, of which a list was prepared a few years ago for the Royal Asiatic Society, number a hundred and forty-two. Their physical and moral characteristics are alike various. From the taint of alien mixture, no people ever took so much pains to preserve themselves as did the Aryans of India. To that end caste was a powerful aid, and yet it did not prove quite effectual. The new-comers formed alliances in time with the more advanced of the aborigines. Greek, Scythian and the later invasions have also played an important part in modifying the population. The coming of Alexander the Great was, like the subsequent conquest by the British, an unconscious meeting again of long-parted kinsmen. After the conqueror's death, a Græco-Bactrian realm preserved the marks of Greek civilization for several generations, but, remote from Hellenic influences and gradually corrupted by alien admixture, the Greek stock in time declined and finally disappeared altogether. Bactrian coins, as M. Francis Pulzky informs us, in his "Iconographic Researches,"[4] show the process of degeneration in successive princes and the inferior character of the later to the earlier workmanship. Eucratides (B.C. 175) is Greek in feature. The likeness of Hermæus keeps up the prestige of a dynasty of Greeks, but Kadphyses, both in his name and features, as well as in the

[1] The Human Species, p. 163.
[2] Preadamites, pp. 57, 58, 59.
[3] Dr. W. Hunter: The Indian Empire, p. 79.
[4] Indigenous Races of the Earth, p. 169.

execution of the artist who reproduced them, gives warning that the day of Greek pre-eminence is drawing to a close. Both he and his dye-sinker, M. Pulzky thinks, were unmistakably half-castes. In India, Alexander had planted garrisons, founded cities, and formed alliances. Seleucus gave his daughter in marriage to Chandragupta or Sandracottus. The grandsons of the two friendly princes entered into renewed treaty relations (B.C. 256), and in the next century the Eucratides already mentioned conquered as far as the modern Hyderabad. The coins of Menander, who advanced farthest into north-western India, are found from Cabul to Muttra on the Jumna. Greek faces and profiles constantly occur on Buddhist statuary, examples of which are seen at South Kensington. Eastward from the Punjaub, the Greek type begins to fade and its effect was probably inappreciable in modifying the physical characteristics of the Hindoos. The traces of other mixtures are more perceptible. Scythian invasion, for instance, did much to transform the population of northern Hindostan, and the influence of the Scythic element on the growth of ideas was considerable. Some writers go so far as to ascribe to Buddha a Scythian origin.[1] The Jats and Dhe, so numerous in the Punjaub, have been identified by General Cunningham and others with the Getæ and Dahæ. The more recent occupations of the peninsula, from the House of Ghazni to Bahadour Shah, must have done much to mingle the blood of the Aryans with that of allied races. It is, indeed, striking testimony to the frequent untrustworthiness of pretensions to pure blood, even when seemingly well-founded, that in India many members of the warrior and other castes, whose privileges are guarded with the utmost jealousy, have been strongly reinforced from ambitious outsiders of the aboriginal and other stocks. In like manner, Dr. Neubauer, a distinguished rabbi, in a paper read before the British Association at Montreal, shows that many Jews whose pride of race would disdain any foreign admixture, are themselves aliens from the commonwealth of Israel.

In Indo-China, in Ceylon, in Java, and elsewhere, both on the Asiatic continent and Indian Archipelago, are the monumental evidences of races that have disappeared. Here and there, also, some lonely remnant, such as the Veddahs of Ceylon, tells what the early dwellers were like. The great region west of the Hyphasis, which constituted the twenty satrapies of Darius,[2] when the ancient Persian empire was at the height of its power, comprised representatives, in every stage of amalgamation, of the Aryan, Semitic and Turanian families. In the Oxus region, the contest between Caucasian and Mongolian has been going on since the dawn of history, and every shade of interblending may still be found among the tribes of the Afghan frontier. The Israelites intermarried with the conquered Canaanites,[3] notwithstanding the command to destroy them. Professor Sayce, who is inclined to think that the Hebrew and Canaanite differed only in their modes of life, considers the Phœnicians to have been modified by intermixture with the aborigines[4] According to the same authority, after the age of the Old Empire, the dominant race in Egypt ceased to be pure, and the Pharaohs of the Twelfth Dynasty had Nubian blood in their veins, while the long domination of the Hyksos and the residence of the Phœnicians in the Delta of the Nile had affected the population of the country. The gradual change of features is shown on the monuments, those of later periods differing essentially from the earlier.

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[1] The Indian Empire, p. 166.
[2] Herodotus iii. 89.
[3] Wilson's Prehistoric Man, ii. 248.
[4] Ancient Empires of the East, p. 182.

Distinct from the Egyptians and yet closely associated with them were the ancient Libyans of North Africa, who probably may be identified with the Iberian predecessors of the Aryans on the opposite shores of the Mediterranean. In the course of time, they, like their hypothetic kinsmen in Europe, were destined to be absorbed by newcomers of every northern and eastern race, as well as by their more ancient rivals, the negroes of the interior. Of the early settlers in Asia Minor, Sayce is of opinion that to the Phrygians alone can be ascribed a fairly pure Aryan ancestry, the Mysians and Lydians being essentially mixed And, if mixed at the remote period before the Ionian migration, the settlement of the Celts in Galatia, and the influx of horde after horde from the inexhaustible *officina gentium* of Mid-Asia, what must Asia Minor have been in later times when all the great empires of the ancient, medieval and modern worlds had successively filled it with their colonists? The explorations of Dr. Schliemann in the Troad show how many successive races had at an early date made themselves masters of that corner of the peninsula alone.

The labours of the palæontologist and the philologist have done much to illustrate the early and later ethnology of Europe. From the rude rival of the beasts of prey of the Canstadt type to the Turkish conqueror of the degenerate Byzantine, they have set before us, with a definiteness that increases with time, the physical features, the arts and, except in the case of the fossil men, the languages of the successive types of humanity by which Europe has been peopled. We know now that, long before the first westward Aryan wave was set in motion, Europe had been inhabited by races, isolated representatives of some of which still speak the ancient languages of their ancestors. On the ground which, starting from the far east, we have already traversed in search of mixed races, the evidence of their existence is thus summed up by de Quatrefages: "In China and especially in Japan, the white allophylian blood is mixed with the yellow blood in different proportions; the white Semitic blood has penetrated into the heart of Africa; the negro and Houzouana types have mutually penetrated each other and produced all the Kaffir populations situated west of the Zulus of Arabian origin; the Malay races are the result of the amalgamation, in different proportions, of whites, yellows and blacks; the Malays proper, far from constituting a species, as polygenists consider them, are only one population, in which, under the influence of Islamism, these various elements have been more completely fused. I have quoted at random the various preceding examples, to show how the most extreme types of mankind have contributed to form a certain number of races. Need I insist upon the mixtures which have been accomplished between the secondary types derived from the first. In Europe what population can pretend to purity of blood? The Basques themselves, who apparently ought to be well protected by their country, institutions, and language, against the invasion of foreign blood, show upon certain points, in the heart of their mountains, the evident traces of the juxtaposition and fusion of very different races. As for the other nations ranging from Lapland to the Mediterranean, classical history, although it does not go back for a great distance in point of time, is a sufficient proof that crossings are the inevitable result of invasions, wars, and political and social events. Asia presents, as we know, the same spectacle; and, in the heart of Africa, the Gagas, playing the part of the horde of Gengis-Khan, have mixed together the African tribes from one ocean to the other."[1]

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[1] The Human Species, pp. 273, 4.

Professor Boyd Dawkins, in an article on "The British Lion,"[1] in which he deals, not with the superb beast of heraldry, but with a genuine *felis leo*, says that a rough type of humanity, the river-drift hunter, was coeval with that animal in Britain. The lion also ranged over France, Belgium, Germany, and Italy,—in those regions, too, having man for his rival in the chase. But in the course of time a convulsive change in the geography of northern and western Europe caused his retreat to more secure and genial hunting-grounds. He was still at large in the forests south of Mount Hæmus until probably the beginning of the Christian era. But what became of the man, his contemporary in Britain? There are some who think that he managed to survive the great terrestrial shocks that frightened the lion eastward, lingering on till the arrival of the Euskarian with whose blood his own became merged, and who in afterdays, by union with the Celt, was to form the basis of the British people. Others decline to accept him as an ancestor, though they are glad to receive the Moor-like Euskarian in that capacity. The descendants of this last neolithic occupant of Britain have been recognized in the so-called Black Celts of western Ireland and Scotland, while their blood has also been traced in a more mixed condition in parts of Wales, in Lincolnshire, in East Anglia and other districts of the United Kingdom.

Mr. Horatio Hale, favouring the hypothesis, based on certain peculiarities of the Basque tongue, that those ancient West-Europeans were of the same race as the Indians of America, credits them with that love of freedom and free institutions which is so conspicuously lacking in the character of the Eastern Aryans.[2] What a train of thought the suggestion, if we could only admit its probability, would open up! It is, however, hardly consistent with the servile condition to which, according to our authorities, the light-skinned Celts easily reduced their dusky forerunners—to be, in turn, themselves, master with serf, enslaved by the all-conquering Romans. One effect of the coming of the latter was to amalgamate the Celtic and Euskarian elements, in those parts of the island where they stood towards each other in the relation of a superior to a subject race. But in Ireland, the Highlands of Scotland, parts of Wales, and elsewhere in Britain, the Euskarian blood continued to predominate, and is still easily perceptible after the interfusions of so many centuries. In fact, all through the successive changes which the population of the British Isles has undergone, "each earlier element has everywhere persisted in the resulting mixture, and it is probable that the numerical proportion of all the older elements, especially the Euskarian, is far greater than people generally at all imagine." [3]

If the Britons were a composite people, it could be easily shown that the Greeks, the Romans, the Teutons and the Slavs, were also made up of various elements. In every case we find a more or less obscure substratum of aborigines on which grew up, by colonization, invasion, *raptus*, or captives taken in tribal war, a more or less uniform population. Time and circumstance, and the chances of human conflict and intercourse, accomplish in that direction what would be impossible if human reason deliberately undertook the task. Contemplating the result, we may well say:—

> "There's a divinity that shapes our ends,
> Rough-hew them how we will."

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[1] Contemporary Review and Popular Science Monthly, Nov. 1882.

[2] The Iroquois Book of Rites, p. 190.

[3] "Our Ancestors," by Prof. Grant Allen, in Nature Studies, edited by R. A. Proctor.

"A thousand years ago," writes Mr. D. Mackenzie Wallace,[1] "the whole of Northern Russia was peopled by Finnish tribes, and at the present day the greater part of it is occupied by peasants who speak the language of Moscow, profess the Orthodox faith, present in their physiognomy no striking peculiarities, and appear to the superficial observer pure Russians." And, for good reason, Mr. Wallace concludes that the Finnish aborigines were neither expelled nor exterminated, but "had been simply absorbed by the Slavonic intruders." In the rest of Europe how often has the same process of absorption taken place!

But it is time to turn from the past to the present, and to inquire whether, where, and to what extent, the intercrossing of the human races is going on in our own generation? As to the main question, we have no hesitation in replying in the affirmative. As to the whereabouts of its occurrence, though, as we shall see, examples are not wanting in the Old World, it is in the American hemisphere that racial interfusion most prevails. There is not a State, indeed, in the entire range of territory from the Arctic regions to Patagonia, which does not furnish characteristic varieties of mixed races. These varieties result from the mixture in different proportions of the European, the Indian and the negro. In his "Narrative of the Surveying Voyages of His Majesty's Ships 'Adventure' and 'Beagle,'" Captain (now Admiral) Fitz-Roy gives a table of twenty-three such varieties, enumerated by Stevenson, as existing in Lima, all consequent on the union of the Spaniard, the aboriginal Peruvian, and the negro. Substituting in Brazil, Portuguese for Spanish, and in the West Indies and North America some other European nationality—French, German, Dutch, Scandinavian, or British—we may adopt the list without much inconvenience. Practically, however, except during the prevalence of slavery, which held its grip on the unfortunate in whose veins there was the least infusion of African blood, such minute distinctions are unknown. When once the negro or Indian element is imperceptible to common observation, the person of mixed blood is considered white. For this very reason, there are not a few not only in the Northwest but in the older provinces of Canada who are, perhaps without suspecting it themselves, of partial Indian descent. One of the most interesting chapters in Dr. Wilson's valuable work, "Prehistoric Man," is devoted to a consideration of the share which absorption in this way has had in reducing the number of the aborigines. "It is impossible," he writes, "to travel in the far west of the American continent, on the borders of the Indian territories, or to visit the reserves where the remnants of displaced Indian tribes linger on in passive process of extinction, without perceiving that they are disappearing as a race, in part at least, by the same process by which the German, the Swede, the Irishman, or the Frenchman, on emigrating to America, becomes in a generation or two, amalgamated with the general stock."[2] Dr. Wilson received striking evidences of the reality of the process during a short stay at Sault Ste. Marie in the summer of 1855. A clergyman of the place, in answer to his inquiries touching the amount of intermarriage or intercourse

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[1] Russia, p. 151.

[2] ii. 250. James Simson makes the same claim on behalf of that singular people, the Gipsies, whose fertility he contrasts with the unproductiveness of the Indians. While the latter, he says, "really die out, the Gipsies are very prolific and become invigorated by mixture of white blood, under the cover of which they gradually leave the tent and scatter themselves over and through society, enter into the various pursuits common to the ordinary natives and become lost to the observation of the rest of the population." The Social Emancipation of the Gipsies, p. 3.

that occurred between the whites and the Indian, pointed to the people of the village, and drew his attention to the evident fact that few of them had not some trace of Indian blood in their veins. Subsequent investigation led Dr. Wilson to believe that what he had seen at the Sault was a fair illustration of what might be observed at any frontier settlement. Nor was it at such localities alone that he noticed the signs of twofold descent. "I have recognized," he says, "the semi-Indian features in the gay assemblies at a Canadian Governor-General's reception, in the halls of the Legislature, among the undergraduates of Canadian universities and mingling in selectest social circles. And this is what has been going on in every new American settlement for upwards of three centuries."[1] Dr. Wilson's statements as to the extent to which traces of Indian blood are discoverable, especially in the Province of Quebec, are, perhaps, more sweeping than some of our French Canadian fellow countrymen would deem justifiable,[2] but we may be sure that an ethnologist like Dr. Wilson would not make assertions which he had not carefully sought the means of substantiating. When he tells us, therefore, that "in Lower Canada half-breeds and men and women of partial Indian blood, are constantly met with in all ranks of life," and cites with approval the opinion that "in the neighbourhood of Quebec, in the Ottawa valley, and to a great extent about Montreal, there is hardly among the original settlers a family in the lower ranks, and not many in the higher, who have not some traces of Indian blood," we should hesitate to reject, on that point, authority which we accept on so many others. By way of illustrating the relations that prevail between the native tribes and the settlers in a new colony, the same author cites the case of British Columbia, as it was some years ago. Of two hundred and six immigrants—British and Spanish, French and Italian, Chinese and negroid—from northern and central Europe and the United States, resident on Vancouver Island, only two were found to be women. Under such circumstances an increase to the population, through association with the squaws that hang round the settlement, becomes inevitable. "And yet," he adds, "long before the province is so old as New England, the descendants of this varied admixture of nationalities will, doubtless, talk as freely of 'Anglo-Saxon' rights and duties as any of the older settlements." A little volume entitled "The Wonderland Route to the Pacific Coast," gives similar evidence as to the multiplicity of human type to be met with in a western border town. In Miles City, a village of 3,000 inhabitants, at the confluence of Tongue and Yellowstone Rivers, there is scarcely an important race, we are told, that is not represented; while the few ladies that keep chivalry alive in the small community are mostly of the aboriginal stock. But it is on Red River that the intermixture indicated has been peculiarly fruitful. The growth of the half-breed population there has probably extended over nearly two centuries, dating from the first intercourse between Europeans and the natives to the present time.[3] In the early years of the seventeenth century the unfortunate Henry Hudson (in the employ of "some worshipful merchants of London") penetrated the great bay that bears his name, but it was not till 1670 that the company called after it received its charter. The rivalry between

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[1] Prehistoric Man, ii. 252, 3.

[2] Sulte denies with indignation the assertion that the early Canadians intermarried (except in very rare instances) with the Indian tribes. See his Histoire des Canadiens-Français, i. 154. Abbé Tanguay also holds such marriages to be of rare occurrence.

[3] Arthur Dobbs, whose account of the countries adjoining Hudson Bay was published in 1744, obtained his information almost wholly from a half-breed trader called La France—a proof that the *Métis* was on the spot at least a century and a half ago.

France and England gave rise to conflicting claims of discovery and possession, the former basing an alleged prior right on the assertion that Jean Bourdon, a French navigator, had entered Hudson Bay in 1656. Similarly opposing pretensions were subsequently made by the fur companies as to the opening up of the interior. The explorations of the Verandryes, father and sons, lasted from 1731 to 1752. After the Conquest of Canada, the fur trade ceased for several years; but in 1766 Montrealers began to push northward. Others subsequently maintained that it was not till 1774, when they and the Hudson's Bay Company's agents met at Fort Cumberland on the Saskatchewan, that the latter reached the interior of the country. It was shown, on the other hand, that Henry Kelsey, a Hudson's Bay Bay Company man, had got as far as the plain country west and south of Lake Winnipeg as early as 1691, or forty years before the Verandrye family began their great enterprises. The North-West Company, formed by the association of all the merchants engaged in the fur trade, was formally established in 1783-4. Some years later a rival company was started, but both these united in 1787. In 1798 there was a secession and another off-shoot from the North-West Company in 1805 was called the X. Y. Company. In 1821, after the Hudson's Bay and North-West Companies had been almost ruined by troubles of one kind or another, an understanding was reached and the two bodies were henceforth known by the name of the older. No doubt, from the first arrival of Europeans in the Northwest, there had, as already intimated, been less or more intermarriage or other alliances between them and the natives. At any rate, from the time that the Montreal traders began their enterprise in 1766, their agents, mostly French Canadians, mingled freely with the Indians, and the consequence was the growth of a half-breed population. When the Earl of Selkirk began his colonization in 1811, there was a considerable community of them, known by their own chosen designation of *Bois-Brulés*, though then, as later, they often assumed the ambitious name of the "New Nation." That the Bois-Brulés were not all of French origin, may be inferred from some of their names which are Scotch (or English). But the English-speaking half-breeds proper date their first appearance from the years immediately following the establishment of Lord Selkirk's Red River Colony. In the latter year, making allowance for subsequent migrations, they numbered about 200. By 1870 the half-breeds and *métis* of Manitoba, as we may distinguish those of British and French origin, numbered about 10,000. Besides them there was a tribe of métis hunters, numbering at one time 6,000, and a métis population of uncertain number scattered through the Northwest, not to speak of the large population of half-breeds among the Indian bands living on reservations in the older provinces.

The original new-comers under Lord Selkirk's auspices were Orkney Islanders, but they were subsequently increased by English, Scotch, and French Canadians. Here, however, as in the more remote Hudson's Bay Company forts and trading posts, the white immigration consisted chiefly of young men, and the natural consequence has been the growth of a half-breed population, distinct in manners, habits and allegiance, from both the whites and the Indians. Dr. Wilson considers the rise in this way of an independant tribe of half-breeds as "one of the most remarkable phenomena connected with the grand ethnological experiment which has been in progress on the North American continent for the last three centuries." Noting the difference of character between those of French and those of British paternity, he considers the former more lively and frank, but also less stable and industrious. They are large and robust, with great power of en-

durance and, while manifesting the reserve of the Indian, display considerable vivacity under excitement. The civilized half-breeds of Manitoba differ from those of the half-breed tribe and from Indians of mixed blood. Some of them are wealthy and their sons in some cases, are sent to college, and on their return home use their knowledge and influence to promote refinement. Generally they resent the term "half-breed," preferring that of "native." The testimony of Archdeacon Hunter and Mr. S. J. Dawson is favorable to the physical and moral qualities of the mixed race as compared with the pure Indians. In 1874, Dr. G. M. Dawson, while employed on the British North American Boundary Commission, came upon the site of the Big Camp of the half-breed hunters to the west of White Mud River. It consisted of more than 200 *tepees* or buffalo-skin tents and about 2,000 horses.[1] In 1845, Mr. Paul Kane reckoned the half-breed hunters of Red River at 6,000. In the hunt or in the war, Dr. Wilson credits them with discipline, courage and self-control, and the conduct of some, at least, of the participators in the recent unhappy rising, confirms that opinion. Marrying freely, as they are said to do, with the white population, there is reason to believe that in the course of some generations the traces of red blood will disappear, not by extinction but by absorption with the dominant race.[2]

Professor G. Bryce, in his work on Manitoba, characterizes the half-breed of an earlier day somewhat differently. "A lithe, cunning, turbulent, but adventurous and lively race," he writes, "were the Bois-Brulés, of those early times. They were chiefly the descendants of the French voyageurs of the North-West Company who had taken Indian wives and settled down on the shore of some lake or river in the Fur Country." Like Dr. Wilson, he is struck with the strangeness of the phenomenon presented by the growth of such a mixed race in the heart of the continent—"a race combining the characteristics of the French and the Indian." Comparing the Bois-Brulés with the Scottish half-breeds, he says: "There can be no doubt that the French half-breeds are of greater stature, are more restive under restraint, more inclined to the wandering life of the Indian, and more given to the hunt and to the use of arms than those of Orkney descent." Again, "like all semi-savage races, the Bois-Brulés are fickle. They must be appealed to by flattery, by threats, or by working upon their animosities or well-known dislikes, would they be led in any particular direction."[3] And the truth of this statement was exemplified in the recent rebellion under Riel and Dumont, no less than in the sanguinary conflict into which they were seduced in 1816.

To what extent Indian blood has been diffused among the white population of the United States, we have no means of ascertaining, but in all likelihood the proportion is much larger than is generally supposed. Attention in that country has been rather, perhaps, directed to the results of miscegenesis between whites and negroes. That it was largely practised in the South in the period before the Civil War, is an undoubted fact. That escaped negroes, sheltered by Indians, in Florida and elsewhere, often took Indian companions who bore them children, is also well established. Since the emancipation of the slaves, intercourse between whites and negroes has decreased, notwithstanding the strong

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[1] Report of the Geology and Resources of the Region in the vicinity of the Forty-ninth Parallel, from the Lake of the Woods to the Rocky Mountains, etc. (British North American Boundary Commission.) By G. M. Dawson, pp. 295, 6.

[2] Prehistoric Man, ii. 266.

[3] Manitoba: its Infancy, Growth and Present Condition, p. 204.

advocacy of intermarriage, as a solution of a difficult problem,[1] by professed friends of the African race. The late Wendell Phillips declared himself an amalgamationist to the utmost extent, and said that his main hope lay "in that sublime mingling of the races, which is God's own method of civilizing and elevating the world." Bishop Haven, with still greater fervour of faith, felt confident that Americans would one day see "Helen's beauty in a brow of Egypt." "We shall say:" he said in one of his sermons, "What a rich complexion is that brown skin!"[2] In connection with the good bishop's faith in the elimination of prejudice among his countrymen, it may not be out of place to recall what Henry M. Stanley has recorded, in the second volume of "Through the Dark Continent," as to the effect produced on him by the sight of white men after being for years accustomed to the dusky hue of African tribesmen. "Proceeding a little further," he says, "we stopped, and in a short time I was face to face with four white—ay, truly white men! As I looked into their faces, I blushed to find that I was wondering at their paleness. Poor pagan Africans—Rwoma of Uzinja, and man-eating tribes of the Livingstone! The whole secret of their wonder and curiosity flashed upon me at once. What arrested the twanging bow and the deadly trigger of the cannibals? What, but the weird pallor of myself and Frank! In the same manner the pale faces of the Embomma merchants gave me the slightest suspicion of an involuntary shiver. The pale colour, after so long gazing on rich black and richer bronze, had something of an unaccountable ghastliness. I could not divest myself of the feeling that they must be sick; yet as I compare their complexions to what I now view, I should say they were olive, sunburnt, dark." Indirectly, perhaps, there is something in these words which explains why the slaveholder was often more generous in his sentiments towards the negro than the philanthropist, whose love for him was purely of an abstract nature.

The ultimate destiny of the black, as of the red race, in North America, is a question of deep interest and importance on which a great deal has recently been written. By the census of 1880 the coloured population of the United States was 6,577,497, that of the whites being 43,402,408. During the ten years from 1870 to 1880 the ratio of increase in the former (34·8 per cent.) was larger than it had been during any decade except one, that from 1800 to 1810. The fact that the ratio of increase of the white population during the period from 1870 to 1880 was only 29·2 per cent., according to the census, naturally occasioned comment and even alarm. In the *Popular Science Monthly* for February, 1883, Prof. E. W.

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[1] "Is it not wonderful?" writes Mr. G. W. Cable, "A hundred years we have been fearing to do entirely right lest something wrong should come of it; fearing to give the black man an equal chance with us in the race of life lest we might have to grapple with the vast, vague afrite of amalgamation; and in all this hundred years, with the enemies of slavery getting from us such names as negrophiles, negro-worshippers and miscegenationists; and while we were claiming to hold ourselves rigidly separate from the lower race in obedience to a natal instinct which excommunicated them both socially and civilly; just in proportion to the rigor, the fierceness, and the injustice with which this excommunication from the common rights of man has fallen upon the darker race, has amalgamation taken place." And, endeavouring to account for the almost entire non-existence of amalgamation in the negrophile North, Mr. Cable asks and answers: "How have they been kept apart? By law? By fierce conventionality? By instinct? No! It was because they *did not* follow instinct, but the better dictates of reason and the ordinary natural preferences of like for like." "The Silent South," in the Century, Sept.,1885. But may it not also be true that familiarity with the negro in the South, even while it bred contempt, had also a tendency to conquer that Caucasian fastidiousness which prevented race-interfusion in the North? Since the war the antipathy consequent on political jealousies and altered race-relations would prove a barrier to intercourse in the South.

[2] Quoted in Winchell's Preadamites, p. 81.

Gilliam, in an article on the subject, based on the statistics of the last two censuses, maintained that the coloured people were increasing at a rate, which, unless prompt measures were taken to prevent it, would result in the inhabitants of the country becoming Africanized. Mr. Henry Gannett, in a recent contribution to the same journal, disputes the data on which Prof. Gilliam founded his argument, and denies that the negroes, either in the cotton States or in the country at large, are increasing so rapidly as the whites, and holds that the fear entertained of the latter being ultimately outnumbered is entirely groundless. But it is vain to expect that so significant a problem can be solved or shelved by merely correcting a few census mistakes. Even if the six and a half millions of African origin were dispersed all through the States, with its forty-three millions of whites, the proportion of the former is large enough to cause uneasiness to those who think that the merging of the two bloods would not improve the race. As Bishop Dudley points out in the *Century*, the coloured residents of the South will almost all remain there where the two races are nearly equal, and if intermarriage takes place, the issue will not be a new people with a small trace of African blood, but a community of mulattoes. The bishop, who, Christian philanthropist though he is, has not yet altogether discarded the sentiments of *ante bellum* days, looks with horror on the equanimity with which Canon Rawlinson contemplates such an experiment in race-fusion. And yet what he cannot accept as a doctrine for the present, may, he admits, be received with favour by generations still unborn. "What may come," he writes, "in the far-distant future, when by long contact with the superior race the negro shall have been developed to a higher stage, none can tell. For my own part, believing, as I do, that 'God has made of one blood all the nations of men,' I look for the day when race peculiarities shall be terminated, when the unity of the race shall be manifested. I can find no reason to believe that the great races, into which humanity is divided, shall remain forever distinct, with their race-marks of colour and of form. Centuries hence, the red man, the yellow, the white and the black may all have ceased to exist as such, and in America be found the race combining the bloods of them all; but it must be centuries hence. Instinct and reason, philosophy, science and revelation, all alike cry out against the degradation of the race by the free commingling of the tribe which is highest with that which is lowest in the scale of development." Dr. Dudley seems to forget that such commingling seldom, if ever, takes place of malice prepense, nor, indeed, are many marriages the result of deliberate forethought. However anxious people may be for pure blood and pedigree and healthy organism in connection with their live stock, it has not as yet become usual to apply the same physiological reasoning to the question of human increase. If, early or late, the races of the United States are destined to coalesce, the union will come about not "with observation," but through the general and almost imperceptible obsolescence of prejudices.

That the aboriginal Indian element has been largely absorbed by the European settlers in the United States as in Canada, is pretty well established. Some of the best families in Virginia and other States have had Indian ancestors. Frontier life has always promoted such unions, and it must be remembered that, in its turn, every portion of the vast region from ocean to ocean has been a frontier settlement. Winthrop has placed it on record, moreover, that, after wars with the natives, it was customary to disperse the women and female children among the towns of the colonists, the male children being sent to Bermuda.[1]

[1] Wilson's Prehistoric Man, ii. 253.

The increase of the Chinese on this continent in spite of all the measures taken for their exclusion, adds still more to the complications of the race problem. The evidence elicited by the commission appointed, by the Canadian Government for the purpose of inquiry into and reporting upon the subject of Chinese immigration, is of an extremely conflicting character. As to intermarriage between Mongolians and whites, Dr. Stout of San Francisco said that such unions had already taken place. Where the man and woman were superior individuals of their respective races, he thought the cross a much better one, than between the negro and the white, or between the white and the Indian. Ex-Chief Justice S. Clinton Hastings, on the other hand, regarded intermingling as ruinous, and thought even the Russian serf or the Irishman (!) superior to the Celestial. Solomon Heydenfeldt, formerly associate Justice of the Supreme Court of the State, took a middle view. He did not think miscegenation would be a success, but he saw more points of similarity between whites and Chinese than between whites and negroes. The Chinese he preferred, as servants, to the general run of immigrants, as being more faithful, reliable and industrious. The fact seems to be that, while experience shows the Chinese to be quick learners and good workers, they differ morally among themselves like other nationalities, some of them being intelligent, educated, polite and well-conducted, while others are of indifferent character, and others again are degraded to the lowest level. As to the blending of the Chinese with Aryans or other stocks on this continent, I have not been able to obtain much information. A late census in Victoria, Australia, returned 160 persons as half-castes—the offspring, in most cases, of Chinese fathers and white mothers. Prejudice would, doubtless, tend to prevent amalgamation in San Francisco, but there, in Portland, Oregon, and other places where the Chinese have resided, as well as in British Columbia, the white and Mongol races must have mingled to some extent. The commissioners have remarked upon the significant contrast discovered between the character and condition of the Chinese in San Francisco, where they are treated as pariahs, and the status and bearing of the same people in Portland, where they and the whites live on terms of amity, their stores, factories and residences standing side by side. In these circumstances they are a thriving and happy portion of the mixed community. In Victoria, B. C., the same contrast was illustrated.

M. de Quatrefages sets down the proportion of mixed blood in Mexico and South America at one fifth of the whole population. But the testimony of trustworthy witnesses makes it much larger. In Mexico, with a population of about ten millions, it is calculated that not more than half a million are of pure European descent, while those classified as Indian number about a half of the whole, or five millions. In Guatemala, Honduras, Nicaragua, San Salvador, and Costa Rica, the vast majority of the people are Indians and *Mestizos*, so that if the scheme of Barrios had succeeded, he would have practically ruled over a federation of half-breeds. In the society of the cities, only a mere sprinkling pretends to pure Spanish descent. In South America, the mixed races are still more numerous in comparison with the rest of the population. In Brazil, the coloured slave or freedman element has mixed with both Creoles and Indians. In Hayti and San Domingo, the blacks are the ruling race. In Venezuela, whites and blacks have coalesced with Indians to such an extent that, with the exception of about a thirtieth part of the population made up of savage aborigines, the great bulk of the nation is mixed. In Peru it is expected that before long the country will have reverted to the aboriginal condition, only about two

per cent. of the inhabitants remaining unaffected by Indian or negro admixture. Though in some South American States, such as Chili and the Argentine Confederation, immigration tends to keep up the supply of European blood, in no case is it in the ascendant.

Prof. Bryce, in the work already quoted, cites the opinion of Chateaubriand, that of all Europeans the French have ever been most in sympathy with the Indians, a fact due to their liveliness, dashing bravery, love of the chase and even of savage life.[1] It was doubtless to that sympathy of sentiment and tastes, joined with the forced or self-imposed isolation of their careers, that their frequent intermarriage were due. The causes which led to the growth of the extremely large half-breed populations of Mexico, and Central and South America, were more complex than those which produced the smaller communities of the North. In Mexico and Peru, for instance, the circumstance that the inhabitants were to so high a degree civilized would be deemed sufficient justification for union on equal terms with the aborigines and, the example having been thus set, it would be likely to be followed as colonization extended from those centres. Some of the most distinguished statesmen, soldiers and writers of Spanish America have been half-castes. Those whose blood is pure are still, however, jealously proud on the score of birth, and would deem it an insult to be classed in the same category with mestizos or mulattoes. In some of the West Indies, where the allophylian element is mostly African, the whites are still more exclusive, the taint of color being a stigma of social inferiority. One large island forms, however, a strange exception. Hispaniola, both French and Spanish, is ruled by blacks, and there it is the mulattoes who lack the conscious dignity of pure superior blood. The picture of the Haïtiens, given by Capt. Kennedy ("Sport, Travel and Adventure in Newfoundland and the West Indies"), is most deplorable. Voodooism, the rites of which are associated with cannibalism, prevails almost openly, and though nominally Christians, many of the inhabitants are still in practice savage heathen of the Congo.

M. d'Omalius has reckoned the number of half-breeds in the world at 18,000,000, his computation taking account only of the products of crossing of the European white and coloured races. But if what has been said of the proportion of half-breeds to the entire inhabitants of the New World alone be correct, it comes far short of the reality. De Quatrefages says that in Mexico and South America the half-breeds contribute at least one fifth of the population, but other authorities generally accepted as reliable—the official accounts in the "Statesman's Year Book," for instance—gave a much higher ratio. For obvious reasons, it would be difficult to obtain trustworthy statistics concerning the distribution of pure and mixed blood in a community where mixture is a mark of inferiority. Half-breeds, fair enough to pass for whites, would not be likely to volunteer the correction of misconception as to their origin. The degree of dark admixture is, therefore, more likely to be understated than overstated.

While this continent offers to the inquirer the most interesting and numerous examples of new ethnic varieties created by intercourse between different races, others to be found elsewhere are well worthy of attention. In the Sandwich Islands, there is the offspring of natives and foreigners of almost every nationality from English to Chinese. Some of the Hawaiian-British half-castes are intelligent, well-conducted and industrious. The ruler of the kingdom, who recently travelled through Europe, is an accomplished gentleman,

[1] Manitoba, etc., pp. 199, 200.

as well as a statesman-like and progressive prince. When it is recalled that little more than half a century ago the Hawaiian group was peopled by savages, meet descendants of Capt. Cook's murderers, the present condition of the kingdom, with its educated and law-abiding citizens, is one of the most striking testimonies that modern history affords to the benefits which the dark places of the world have derived from well-directed missionary labour. Tahiti, the capital of which is described as a miniature Polynesian Paris, is another instance of successful missionary and colonizing enterprise, and equally remarkable has been the transformation which the establishment of British rule has effected in Fiji. Unhappily, the contact of even the best civilization with aboriginal races is not always a boon to the latter. The Maoris, one of the finest of the dark-skinned occupants of Polynesia, have dwindled away in the hopeless struggle with an aggression which they were not strong enough to resist and were too proud to conciliate. Neither in their native New Zealand, nor in the lost heritage of the far inferior Australians, has a half-breed population sufficiently large to affect the destiny of the colonies as yet sprung up. To what extent the presence of convicts in New Caledonia has affected the half-breed problem, a writer in *L'Expansion Coloniale* gives us some means of judging. M. P. Joppicourt, in a clever contribution to that journal, presents a striking, though melancholy picture of the *popinées*, or native companions of the French settlers or pardoned criminals. While the rare French women, who have ventured to share the discomforts and perils of such an exile, are petted and courted in Noumea (the capital of New Caledonia), away off in the bush, the poor faithful *popinée* hugs with rapture the white man's child of which she is the proud and loving mother. She looks upon her husband as her master, and does homage to her own offspring as of a superior race. For their sake, she has severed herself from her tribe and refrains from the use of her own language, lest her little ones should be thereby degraded. Her kindred have turned against her as a renegade, but she minds not their reproaches. Alas! a day comes when they have their revenge, when the white man closes his door against her and bids her begone. She has served his purpose and he needs her no longer. He is paying suit to a countrywoman of his own, and the *popinée* must get out of the way. And so, with misery in her heart, she betakes herself with her children back to the tribe where for a long time she must put up with taunts and every humiliation. But she, too, has her revenge. By and by, love changes to bitterness and his children learn to hate the name and race of the father who has disowned them. When the cry of war is raised, they are the most eager to sink their battle-axes in the white man's skull, to burn his farm, to massacre his wife and children. And thus the innocent and good pay with their lives for the craven treachery of a heartless wretch. Let us hope that the picture is not representative, but exceptional. The same writer seems to see in the half-breed some ground of hope for the future of a colony avoided by the luxurious ladies of France. "Has not South America," he asks, "been entirely peopled by the crossing of Spaniards and Indians? Yes: those *mestizos* have formed powerful and respectable nations. And in North America, too, it was by allying themselves with the willing daughters of the Abenakis that the sons of France created that vigorous Acadian stock, whose patriotic spirit has more than once kept at bay the proud rulers of Old and New England. 'What a pity,' said the Indians after the capitulation of Quebec, 'that the French were conquered! Their young men used to marry our daughters.' Those mixed marriages gave us faithful allies and enabled our colonists, abandoned by the Mother-country, to make head for a

century against the inexhaustible forces of Great Britain." In like manner may the *popinée*, he thinks, prove the mainstay of France in the Pacific.

There is no more romantic and extraordinary instance of a new human variety starting into life and, in spite of deplorable beginnings, taking on the better characteristics of the wild and the civilized race, than that of the Pitcairn Islanders. The story is well known and I need scarcely repeat it. It may suffice to say that after the tragedy of the Bounty, the refugee mutineers, nine English sailors, accompanied by six men and fifteen women of Tahiti, settled on that little isolated islet. By feuds of race the colony was reduced in four years to four white and ten Tahitian women. A few years later, Adams, the pious patriarch of the community, was the sole survivor of the repentant mutineers. But, meanwhile, children had been born, who grew up and married and had families, and in 1830 the population of the island was eighty-seven. Some of them were then transferred, at their own desire, to Otaheite, but they had been religiously trained, and the loose morals prevalent there disgusted them. So most of them returned home within the year. In 1856, a second experiment at emigration was made, Pitcairn proving too small to support the rapidly growing population. But Norfolk Island was nearly as distasteful to the half-breeds as Otaheite had been, and in a few years they had almost all come back. When Admiral de Horsey visited the colony in 1878, he found sixteen men, nineteen women, twenty-five boys and thirty girls—in about sixteen families. At that time the elected governor was James Russell McCay, steersman of the island whaleboat, of which he was also the builder. The law of the land was the simple, but morally rigorous, code drawn up by Adams. The colony, as the admiral described it, was a community of contented, friendly, gentle, pious people, poor but happy, strict in attending to their religious duties, and taking their recreation mainly in the form of music, most of them being good singers. A later visit to Pitcairn of an English vessel was some time ago described in the London *Daily Telegraph*.

The communities of half-breeds to which I have been directing attention are mainly composed of English, French or Spanish, blended with some coloured race. The Portuguese, like their neo-Latin kinsmen, have ever been known to mingle their blood with that of aliens in all parts of the world. In Brazil, on this Continent, they are largely represented in combination with both the Indian and the negro, while instances are not wanting in which the blood of the three is blended in various proportions. In Africa, the same people has mixed with the natives of both the east and west coasts. In Asia, though none of their colonies are large, compared with those of England, their position was one of influence before the stream of exploration had drawn other nationalities eastward. The Malay word, *Mandarin*, so associated in our minds with the despotic system of the extreme Orient, was one of the prizes of early Portuguese exploration, and it is one of several terms and phrases which the daring countrymen of Camoens have, by origination or adaptation, caused to pass current in the whole world of commerce and diplomacy. Even in lands where their influence has waned, the vestiges of their former power remain in the language of the people. On landing at Batavia in the autumn of 1878, Mr. H. O. Forbes heard, here and there amid the Babel of foreign tongues that assailed his ears, "a Portuguese word still recognizable, even after the changes of many centuries, veritable fossils imbedded in the language of a race, where now no recollection or knowledge of the peoples who left them exists." And at a later date, while visiting the shops and offices of Dilley, in Timor, he was astonished "to find all business conducted, not as in the Dutch pos-

sessions, in the *lingua franca* of the Archipelago, Malay, but in Portuguese."[1] Where the Portuguese have imposed their language, it is only to be expected that they have to some extent mingled their blood with that of the people who speak it. In Goa, Hindostan, Macao, China, famous from its association with Camoens, and in the scattered insular possessions of Portugal, as well as in other parts of the East, there is a considerable population of Portuguese half-castes. Among the 6,000,000 of the Philippines, Spanish mestizos are also numerous. In Manilla, the capital, they form a considerable proportions of its population of 180,000. Of people of Dutch mixed with native blood there must be a good many in the Dutch East Indies. The Griquas of South Africa form, however, the most interesting example of a Dutch half-breed community. In Japan, there is also a population of partially Dutch descent. Intermarriage between the ruling and the subject race in Hindostan, though not so frequent as it would be in like circumstances, if any of the neo-Latin races held the position of the English, is by no means unknown, nor, where the social conditions are on a par, is there any degradation attached to it. Ceylon furnishes many examples of mixed blood, the European element being Dutch, Portuguese or English. The extent to which the East and West have amalgamated west of the Arabian Sea, it is impossible to say, but, if the truth were known, it would, perhaps, surprise the sticklers for Caucasian exclusiveness. Travellers are constantly meeting with Europeans of almost every nation in out-of-the-way corners of the world, where they have made themselves homes and taken them wives of the daughters of the land. When, in 1836, the late Charles Darwin and Capt. (now Admiral) Fitz-Roy visited the Cocos-Keeling group in the Indian Ocean, they were surprised to find that Mr. J. C. Ross, with a *familia* of orientals, had taken up his abode in those lonely islets. Yet, Mr. Ross himself had been no less surprised to discover that another adventurer, Mr. Alexander Hare, had anticipated him. When Mr. H. O. Forbes visited the islands in 1878, he found Mr. Ross's grandson still in possession and quite happy in his self-imposed exile from civilization. The inhabitants on the last occasion were found to be nearly all of mixed blood, the proprietor himself having married a Cocos-born wife.[2]

If it would not tend to prolong this essay indefinitely, many more instances might be recorded. There is hardly a portion of the East in which abundant evidence is not obtainable of the mixture of race already accomplished or now going on. The Malay Peninsula, Burmah, Siam, Cochin-China, Hong-Kong, the seaport cities of China and Japan, besides the countries already mentioned or alluded to, furnish testimony to the fact, enough to satisfy all who seek information on the subject. The following picture of the racial variety to be met with in an Eastern city shows, at least, what opportunities exist for intermixture: "The city is all ablaze with colour. I can hardly recall the pallid race which lives in our dim, pale islands, and is costumed in our hideous clothes. Every costume from Arabia to China, floats through the streets: robes of silk, satin, broadcloth, and muslin; and Parsees in spotless white, Jews and Arabs in dark, rich colours,—Klings (Natives of Southern India) in crimson and white, Bombay merchants in turbans of large size,—and crimson cummerbunds. Malays in red sarongs, Sikhs in pure white, their great height rendered almost colossal by the classic arrangement of their draperies, and Chinamen from the coolie, in his blue or brown cotton, to the wealthy merchant in his

[1] A Naturalist's Wanderings in the Eastern Archipelago, pp. 6 and 417.
[2] *Ibid.*, p. 17.

frothy silk *crêpe* and rich brocaded silk, made up—a medley irresistibly fascinating to the stranger."[1] Such is Singapore, and not far off is Malacca, one of the oldest European towns in the East, originally Portuguese, then Dutch, and now, though nominally under English rule, practically a Chinese colony. Not less striking is Mr. Forbes's sketch of a street-scene in the capital of Portuguese Timor: "Tall, erect indigenes mingle with negroes from the Portuguese possession of Mozambique and the coasts of Africa, most of them here in the capacity of soldiers or condemned criminals; tall, lithe East Indians from Goa and its neighbourhood; Chinese and Bugis of Macassar, with Arabs and Malays and natives from Allor, Savu, Roti and Flores; besides a crowd in whose veins the degree of commingledness of blood of all these races would defy the acutest computation."[2] The Timorese themselves represent the Malay, the Papuan, and the Polynesian races. But they, also, offer exceptions which cannot fail to strike the beholder with wonder. For instance, the same author writes: "While in the act of turning from watching this human hunt to continue my journey, my eye lighted on an object that riveted my interest more than all else among those savage marketers—a red-haired youth, first one, then a few others, some with straight, some with curly hair, with red eye-lashes, blue eyes, and the hair over their body also reddish. I found, on inquiry, that a little colony of them, well known for their peculiar colour of hair and eyes, lived at Aitúha, at no great distance off. Though they lived in a colony together, they were not shunned by their neighbours, who even intermarried with them. The offspring of these unions took sometimes after the one, sometimes after the other parent. In looking eagerly at their faces, I saw more than their features only; their presence there was an excerpt out of a long history. In imagination I saw past them down the dim avenues of Time—a far, far cry—to their early progenitors, and pictured their weary retreat, full of strange and romantic vicissitudes from a more northern clime, till forced off the mainland by superior might into exile in this remote isle, where as a surviving remnant amid its central heights, they are living united but not incorporated with the surrounding race whose pedigree has no link in common with their own."[3]

Space will not permit me to more than allude to the race-mixtures of Hindostan and its border lands, of the Afghan frontier uplands, where Mongoloid and Caucasian still contend for the mastery,[4] of the important region once swayed by the sceptre of Darius, of the lands of the Sultan, of the many-tongued realm of the Czar and the long, deep range of Arab conquest in Africa. Of what blood-fusion did for that part of the world, the broad seat of successive empires in the distant past, I have already spoken. And the transformation is still going on. The sons of Joktan and Ishmael, with the Koran in their hands, have been trying for ages to convert the dark tribes of Africa to the creed of the Moslem, and, in preaching their gospel, they have not disdained to share their ancient lineage with their dusky disciples. Arabic scholars have, by the cruel fortunes of the slave-hunt, found themselves enthralled to Brazilian half-breeds, their protests availing nothing against the evidence of their skins. Whether the crusade inaugurated and sanctioned by

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[1] Isabella Bird in the Leisure Hour. [2] A Naturalist's Wanderings, etc., p. 418. [3] *Ibid.*, pp. 464, 65.

[4] Mr. A. H. Keane (Nature, Jan. 8, 1885) divides the North-Afghan tribes into Caucasic and Mongolic; and again the former, into Galchas and Iranians, and the latter into Mongols and Tartars. The Galchas are subdivided into Siah-Posh, Badakshi, Wakhi and Shugnaris; the Iranians, into Kohistani, Firuz-Khoi, Jemshidi, Tajiks and Afghans. The Mongols are composed of Hazarahs and Airnaks, and the Tartars, of Salor-Turkomans and Kataghani Usbegs. The Caucasians number something over a million, and the Mongols over a million and a quarter.

the powers that constituted the Congo Free State will prove a more successful civilizer than the Arab's mission remains to be seen. If it fails to blanch the negro's skin, it may, and it is to be hoped that it will, liberate his mind from superstition and prejudice by its higher teaching and example.

It will thus be seen that the half-breed has played a most important part in the advance of mankind to the stage of progress which it has reached to-day. In his great work on anthropology, Dr. Topinard maintains that there is not a single pure race on the globe at the present time, every group having been crossed and mixed over and over again. It has been seen that this process is still going on, and more actively now than ever before. Improved means of communication such as even a century ago had hardly been dreamed of, have brought and are constantly bringing the most widely severed and diverse communities into intercourse with each other. The movement of men to and fro over the face of the earth never ceases. Business and pleasure, war and philanthropy, science and trade, are each, with its own aim and by its own methods, penetrating day after day the obscure places of the globe. And every fresh discovery of human habitation gives rise, sooner or later, to some new phase of inter-crossing. Individual men move along the paths of their destinies, not knowing the goal that awaits them. And tribes and nations are still blinder as to the future than individuals. Unconsciously in the past, impelled by hunger, or ambition, or tribal wrath, or religious enthusiasm, or love of adventure, they laid the foundations of the races that were to be. And, under changed conditions, and with different motives, but alike unthoughtful of results, contemporary humanity, with its thousands of conflicting passions and aspirations, is engaged in the metamorphosis, by interfusion, of its own form and features and character. The change is imperceptible. The half-breed comes and disappears, and with him nations of men seem to pass out of existence. But they have merely been absorbed and by absorption helped to transform others. Now and then, the transition takes place on a scale so comprehensive or in circumstances so peculiar as to compel attention and even to excite alarm. It is only then, perhaps, that the fact and its significance are brought home to our minds. But in some form the half-breed question is never far from us. Now, as ever, though it may seem to be localized and isolated from the general concerns of civilization, it is in reality, directly or indirectly, co-existent with the interests of the human race. We meet it at every turn, on every continent, on every sea. And, more and more every day, is it complicated by new issues that must be faced. Every phase of immigration or intrusion of an inferior race among the communities of a superior one, or the reverse; every attempt at colonial expansion; every frontier difficulty, where civilized nations have undertaken to direct the destinies of uncivilized or half-civilized clans; slavery and its suppression; the coolie trade, and other outcomes of the labour question; wars of conquest, exploration, or commerce, in savage regions; the establishment of ports of call and coaling stations at points midway in great oceans or on coasts remote from ordinary traffic; the fur trade; the hunting of larger game; geological and topographical surveys, and scientific expeditions by sea and land; and last but not least, the bearing of the message of peace and salvation to the moral wastes of the earth—all these forms of human endeavour, policy, ambition, curiosity, or zeal, will be found to touch at some point or other on the problem of the half-breed.

II.—*Vita sine Literis.*

By JOHN READE.

(Presented May 28, 1885.)

In an age to which the Preacher's words as to the endless making of books might almost seem to have prophetic reference, it is not easy to realize a state of society in which there were no books at all. And yet, with our means of rapid communication, it would not be difficult for one living in the very heart of civilization to be transported in a few days to regions, which are as bookless as were the shores of the St. Lawrence when Jacques Cartier sailed up that river. Prolific as is the modern press and varied as is its offspring, there is comparatively but a mere handful of humanity that either knows or cares anything about its operations or its products. In some countries—Great Britain, France, Germany, the United States—the proportion of the inhabitants who can read and write is pretty large. But if we consider the totality of what is called civilization, it will still be found that, in comparison, the number of readers is extremely small.[1] Much smaller, if we contemplate the millions of humanity on the globe, will be the ratio of those to whom the book is a thing of necessity. If, indeed, as has been said, life without letters is death, then the vast mass of mankind has not yet begun to live. To imagine, then, what the world was like, when there were no books, we have only to fancy what it would be if it were altogether, as to tastes and opportunities for gratifying them, what certainly more than nine tenths of its inhabitants still are. And for countless ages it remained in that condition—without books or any thought of books.

The life of humanity is so long that, compared with its whole duration, that portion of it, of which we have written or even monumental records, is entirely ephemeral. If we wish to get at the beginning of any art or industry, we must antedate history by a great many centuries. The Greeks, we know, had a fashion of cutting short the labour of research by massing the successive strivings and experiments of many generations under a single name. Æsculapius, Amphion, Dædalus, Minos, stood for the achievements in medicine, or music, or architecture, or law-making, of a great number of earnest workers and thinkers. If we ask to whom we are indebted for the boon of letters, the answer from many sources will be Cadmus, the Phœnician. And in this, as in the other cases mentioned, there may be something of truth. It was through the Phœnicians that the Greeks obtained their alphabet. But many minds had set themselves to the problem before the Phœnicians or other Semites had received the hint which they turned to such good account. Long before their day of power, the inventive genius of the Egyptians had almost mastered the

[1] "I don't suppose that we who have the habit of reading, and at least a nodding acquaintance with literature, can imagine the bestial darkness of the great mass of people—even people whose houses are rich and whose linen is purple and fine." The Rise of Silas Lapham, by W. D. Howells.

secret of alphabetic writing. But if we look for the first germ of the discovery, we must go back to a period compared with which even Egypt's earliest dynasty is recent. The brooding hunter of the early world, who traced on his cave-wall the rudely pictured story of his rough and peril-fraught life, was the father of literature as well as of art. In a paper contributed to the *Art Journal* some time ago on "Field Sports in Art," Mr. Richard Jeffries, discussing the engraved tusk found in the cave of La Madeleine, asked whether the ignorant savage of that long-lost day could have been capable of such work. Happily, apart from the authenticity of the find itself and other finds of similar quality, there is ample evidence in our own time of the existence amongst the lowest races of like artistic taste and skill. "Even the most degraded and savage of the Bushman race," wrote the late Sir Bartle Frere,[1] "who live on insects, reptiles and carrion, and through long privation have been reduced almost to the level of the beasts of the field, have a power of delineating and colouring animals, human beings, and other forms with which they are familiar, with a facility and truth which would be wonderful in a civilized population." Similar skill as draughtsmen has been observed among Australians and, as we shall see, some of the American Indians excelled and still excel in the same process. Whether the unknown artists of the caves came in the course of time to apply their skill to mnemonic, epistolary, or historic uses, we do not certainly know, but from what took place among savages of later date, it is not impossible—it is even probable—that they did. The employment of picture-writing for purposes of communication has been ascertained to be common to almost all rude tribes. In some cases the development was interrupted at a low stage; in others, it reached a point more advanced, while only in a very few instances has it resulted in the elaboration of an alphabetic system. We can easily imagine that men who could carve, with precision and even beauty of finish, mammoths, horses, rein-deer, bears, foxes, and human figures, in spite of disadvantages of implements and material, would be intelligent enough to recognize the use to which such carvings might be put for mnemonic or historic purposes. The picture, which, in the first place, showed merely the surroundings and occupation of the draughtsman, might be made to stand for himself or, by attitude or position, to indicate his condition, intention, hopes or needs. Of pictorial representation of this kind instances abound.[2] A further step is gained when the figure of an object is made to suggest, not itself, but some quality which it calls up in the mind, as when the fox becomes the symbol for cunning, the bird, for swiftness, and so on. The next stage is what is well known as the *rebus*, in which things are put for words, and an important advance is made when the pictures stand no longer for the objects they suggest, but for the sounds of those objects. Altogether, starting with the simple picture, Isaac Taylor enumerates five stages in the invention of the alphabet. These are the simple picture, the pictorial symbol, the verbal sign, the

[1] Proceedings of the Royal Colonial Institute for the year 1880–81, p. 140.

[2] A very good example of it is the pictograph of an Indian petition to the President of the United States, which was originally published by Schoolcraft, but has since done duty in several works. Therein the chiefs are represented by their totems—the crane, marten, tortoise, bear and cat-fish. The eyes of the petitioners are joined by means of lines with those of the head-chief (Oshcabawis) to express their unity of view, and their hearts with his to denote unity of sentiment. An exterior line connects the head of Oshcabawis with the lakes claimed by the petitioning tribes. In the signatures of the Indians to the Selkirk Treaty (1817) their totems not only take the place of the ordinary cross of the illiterate, but are also set opposite the tracts of country that they claim. Morris's Treaties of Canada, p. 298.

syllabic sign, and the alphabetic sign or letter. The first of these, and probably the second, was reached in far-off prehistoric times. The ingenuity of several nations has brought them to the first of the phonetic stages; the victory of invention, by which transition from the verbal to the syllabic phonogram was effected, fell to the lot of few; while fewer still achieved the ultimate triumph of the alphabetic form.

One of the most primitive mnemonic contrivances was, strange to say, common to both extreme East and extreme West. In Pauthier's "Chine Moderne" is given an extract from the Commentary of the illustrious Khoung-Tseu, which reads thus: "In high antiquity knotted cords were used in the administration of affairs. During succeeding generations, the holy man (Fou-Hi) substituted writing for them." This mode of keeping records must have closely resembled the *quipu* of the Peruvians, which, as Prescott informs us, "was a cord about two feet long, composed of different coloured threads, tightly twisted together, from which a quantity of smaller threads were suspended in the manner of a fringe. The threads were of different colours and were tied together into knots; the word *quipu*, indeed, signifies 'a knot.' The colours denote sensible subjects; as, for instance, white represented silver, and yellow, gold. They sometimes also stand for abstract ideas; thus white signifies 'peace,' and red, 'war.' But the *quipus* were chiefly used for arithmetical purposes, and could be combined in such a manner as to represent numbers to any amount they required."[1] But though the *quipus* greatly aided in the performance of calculations and assisted the memory in other ways, they could not be expected "to represent the manifold ideas and images which are expressed by writing." Prescott, indeed, places them far below the hieroglyphics of Central America or the picture-writing of the Aztecs, and regards the ignorance of the Peruvians of those superior systems as evidence that the two civilizations were quite distinct. Dr. Wilson, while taking the same view as to the inferiority of the *quipu* to the northern inventions, hesitates, on the authority of Valencia and Humboldt, to ascribe to the Peruvians an entire unacquaintance with any better method of recording events.[2] But even Valencia admits that the Peruvian picture-writing was less meritorious than that of the Mexican. Rivero and Tschudi believe that there are still, in the Southern provinces of Peru, Indians able to decipher those intricate memorials, though they guard their knowledge as a secret inherited from their ancestors.[3] The attempts of the learned to penetrate their mystery have hitherto failed.[4]

With the knotted cords of the ancient Chinese and the *quipus* of the Peruvians, may be compared the wampum of the North American Indians, composed of variously coloured beads woven into a belt. According to some authorities, Hiawatha, the patriotic founder of the Iroquois League, was the inventor of wampum. But Mr. Horatio Hale is convinced that the honour is not due to his hero. "The evidence, of sepulchral relics, shows," he says, "that wampum was known to the mysterious Mound-builders, as well as in all succeeding ages."[5] From the account given by Mr. Hale, all through his valuable work, of the uses assigned to wampum, it is evident that it was intended to assist the memory in the same way as the *quipus* served that purpose. The whole subject is admirably and

[1] Conquest of Peru, ch. iv.

[2] Prehistoric Man, ii. 72, footnote.

[3] Peruvian Antiquities, translated by Hawks, p. 112.

[4] Knotted strings are used by the Pelew islanders in the present day for mnemonic purposes and as a means of communication. Bell's System of Geography, vi. 490.

[5] Iroquois Book of Rites, p. 24.

fully treated in the paper on "Art in Shell of the Ancient Americans," accompanied by many beautiful illustrations, by Mr. William H. Holmes in the Second Annual Report of the Bureau of Ethnology, Washington. Though it is "not possible from any known records to demonstrate the great antiquity of this (the mnemonic) use of wampum," Mr. Holmes does not think it probable "that a custom, so unique and wide-spread, could have grown up within the historic period," or "that a practice foreign to the genius of tradition-loving races could have become so well established and so dear to their hearts in a few generations." In his opinion, its archival use might have originated in the practice of exchanging gifts, which were preserved "as reminders of promises of assistance or protection." He thinks that in time "the use of such mementos would develop into a system capable of recording affairs of a varied and complicated nature,"—the colours and patterns of the strung beads suggesting, by association, facts, incidents, or solemn engagements, which had been "talked into" them. They were useless, however, without an interpreter, and it was usual among the Onondagas for one member of the tribe to hold the position of *royanner* or hereditary wampum-keeper. If I understand Mr. Hale aright, such official annalists were employed by all the nations of the Iroquois confederacy. Mr. Holmes's splendid series of illustrations includes a picture of the famous Penn Treaty belt, now in the cabinet of the Historical Society, Philadelphia. It was delivered to Penn, by the chiefs of the Lenni-Lenape under the elm-tree at Shackamox in 1682.

Like expedients for aiding the memory were, no doubt, in vogue in remote times in many parts of the old world as well as of the new. As already mentioned, the Chinese have a tradition that at a certain period in their early history, writing by pictures was substituted for the knotted strings previously in use. Pauthier, following the chronology established by the Imperial Academy, under Kuen-Lung, in 1767, assigns the sixty-first year of the reign of Hoang-ti as the beginning of the historic period. The institution of a tribunal of history, attributed to that emperor, implies that writing was quite familiar in his day. A few centuries later Yu (who died in the year B. C. 2108) is said to have had an inscription carved on a celebrated mountain, Heng-Chan, and this inscription is said to be still visible, though almost effaced by the lapse and wear of many seasons. But an exact copy of it, in the primitive characters of Fou-Hi, is preserved in the museum of the ancient city of Si-Ngan-Fou, in the province of Chensi. Father Amyot, the famous missionary and sinologue, had a transcript and translation of it sent to the Bibliothèque Royale of Paris. If, as Pauthier seems to believe, that document can be depended on as a genuine copy of an inscription of the twenty-second century before Christ, the honours of epigraphic antiquity, hitherto almost monopolized by Western Asia and Northern Africa, must be shared with the long-enduring civilization of the far East. Between the time of Fou-Hi (B. C. 2950, or, as some maintain, B. C. 3369) and the date in question, the credit of the discovery or invention, or of some marked improvement on processes already in use, is attributed to various emperors and ministers. The most interesting of these traditions ascribes the gift of writing to certain barbarians from the South, who visited the court of Yao, in the twenty-fourth century before Christ. Pauthier asks whether such a story could point to intercourse with Phœnicia or Egypt. The discovery made not long since of a connection between the most ancient literature of China and that of the Turanian founders of Babylon may more hopefully indicate its origin.[1]

[1] London Quarterly Review, July, 1882.

However that may be, there is evidence enough, in the eight varieties of writing of which the characters are preserved, of the steps by which the Chinese system was evolved. The most ancient form (that of Fou-Hi), shewn in the inscription of Heng-Chan, represents simple figures of things,—a man, dog, horse, tree, being suggested by such drawings of those objects as a child might make. The characters of Fou-Hi gave place (B. C. 820) to the Ta-Chouan or ancient figurative style. About B. C. 227, this style underwent a considerable modification which, twenty-seven years later, was still further transformed into a near approach to the modern writing. The four remaining varieties are the usual, the cursive, the square (for printing), and the current (also for printing). The changes thus indicated took place between the years, A. D. 960 and 1123. The characters used by the Chinese are variously classed, according to their import, according to the objects represented (whether of things celestial, of mountains, of plants, etc.), or according to the number of strokes or radicals (from one to seventeen) that they comprise. The first classification admits of six grand divisions:—the purely figurative; the indicative (altered from their first shape, but not enough to preclude its recognition); the combined (as two trees for forest); the inverse (the meaning of which is implied by the direction, as a hand turned either way to indicate right or left); the ideo-phonetic, and the metaphoric. Of the first class, with its ten subdivisions, there are 588 characters; of the second, with two subdivisions (the second being again subdivided into three), there are 107; of the third class (two subdivisions), 740; of the fourth (four subdivisions), 352; of the fifth (two subdivisions, the second of which comprises six distinct classes), 21,810; and of the sixth (with thirteen subdivisions), 598. It will be seen that the fifth class, or ideo-phonetic, comprises the nineteen twentieths of the 24,175 Chinese symbols. Enormous as is this number and well calculated to deter the inquiring student, it is, like many an obstacle, worse than it looks. For whoever has mastered the figurative and phonetic values of the 1,400 characters of the first three classes is in a fair way to overcome a difficulty which at first sight seems so formidable. Nevertheless, even for the Chinese, this conventionalized picture-writing is cumbrous and its acquisition, a thing of labour. Isaac Taylor says that "even to obtain such an acquaintance with it as to be able to write a common business letter, or to read an ordinary book, it is necessary for a Chinese student to commit to memory some 6,000 or 7,000 of these groups of characters."[1]

The Japanese became acquainted with Chinese civilization and Buddhism in the third century, and adopted the Chinese system of writing. But their language being polysyllabic, they had to treat the Chinese characters as syllabic signs. Selecting a sufficient number of phonograms, and rejecting the "keys" or "radicals" as unnecessary, they greatly simplified the original system. Having only five vowels and fifteen consonantal sounds, they require only seventy-five possible combinations of a consonant and a vowel, and of these several occur rarely. It is possible, indeed, with less than fifty distinct syllabic signs to write any Japanese word. The two syllabaries, which were in working order before the end of the ninth century are called the *Hirakana* and the *Katakana*. The former, derived from the Chinese cursive form, has some 300 signs, many of which are variants or homophones. The other, which is more simple, was obtained from the Chinese *Kyai* or "model type" and comprises only a single sign written more or less cursively, for each of the forty-seven syllabic sounds in the Japanese language.[2]

[1] The Alphabet, i. 32.

[2] *Ibid.*, i. 35.

At this stage of simplification, the development of the Japanese syllabary was arrested —it never grew into an alphabet. Some hold, it is true, that the Corean alphabet is an out-growth of the Japanese *Katakana*, but Isaac Taylor thinks that he is justified in classing it rather with the Pali or Buddhist alphabets of the Indian family.[1]

"Writing," says Prof. Max Müller, "was unknown in India before the fourth century before Christ, and yet we are asked to believe that the Vedic literature, in its three well-known periods, the Mantra, Brahmana and Sutra periods, goes back to at least a thousand years before our era."[2] Prof. W. D. Whitney hesitates to accept this as an established fact. "It is not very difficult," he says, "to conjecture a reason why the Brahmans may, while acquainted with letters, have rigorously ignored them, and interdicted their confessed use, in connection with their sacred literature."[3] It is certain that writing was well known in India in the middle of the third century B. C., as no less than seventeen versions of the famous edicts of Asoka have been discovered, engraved on rocks and pillars in all parts of the great peninsula. In one of these, what is known as the Indo-Bactrian alphabet was employed. The alphabet used in the others, happily deciphered by Prinsep, is termed by Taylor the *Asoka*, in honor of the illustrious author of the edicts. It is also variously called the South Asoka, (to distinguish it from the Indo-Bactrian or North Asoka), the *Magadhi* and the *Maurya* (from the names of Asoka's kingdom and dynasty), the Indo-Pali and, simply, the Indian alphabet. This alphabet is the source of the countless Indian scripts—Tibetan, Pali, Nagara, Dravidian and Malay, which now divide with Chinese and Japanese the literary empire of the East. But both Indo-Bactrian and Asoka, which differ materially from each other, must have been developed from some older graphic system, and several theories have been propounded to account for their origins. Some trace them to the Greeks, others to the Semites, while a third class of inquirers maintain that they are native to the soil. To the theory maintained by Gen. Cunningham that they grew out of a primitive picture-writing, Mr. Taylor objects that the parent script evidently possessed a small number of signs which had to be augmented by differentiation, whereas analogy would demand a number of characters far in excess of the requirements of an alphabet. He will only admit the bare possibility of their native origin. To persons not deeply versed in the science of epigraphy, it might seem more difficult to believe that a people who had produced such a literature as the Indians should not have developed an alphabet, as its normal and almost necessary accompaniment. The policy of Asoka shows that, if the Brahman priesthood were unfriendly to the *litera scripta* for sacerdotal reasons, the less exclusive Buddhists were glad to avail themselves of its aid in spreading their doctrines. Commenting on the fact that the inscriptions of Asoka were composed neither in the Sanskrit of the Vedic hymns, nor in the later Sanskrit of the Brahmanas and Sutras, but in the local dialects as then spoken in India, Professor Max Müller thus questions and answers: "What follows from this? First, that the archaic Sanskrit of the Veda had ceased to be spoken before the third century B. C. Secondly, that even the later grammatical Sanskrit was no longer spoken and understood by the people at large; that Sanskrit

[1] The Alphabet, i. 36. A journal has recently been established in Japan (the *Romaji Zashi*) with the object of introducing the Roman alphabet in spelling Japanese words. It is partially supported by the Government and is the organ of a society of 4,200 members, whose aim is the substitution of Roman for Chinese characters in Japanese.

[2] India: What can it teach us? Lect. vii.

[3] Oriental and Linguistic Studies, p. 86.

therefore had ceased, nay, we may say, had long ceased to be the spoken language of the country when Buddhism arose, and that therefore the youth and manhood of the ancient Vedic language lie far beyond the period that gave birth to the teaching of Buddha, who, though he may have known Sanskrit, and even Vedic Sanskrit, insisted again and again on the duty that his disciples should preach his doctrines in the language of the people whom he wished to benefit."[1] It surely would be as natural to suppose that the scholars and thinkers who spoke that ancient tongue had evolved a method of writing it, even though, for the reasons Prof. Whitney has given, they chose to limit its use; as that their descendants should have been forced to borrow an alphabet from strangers who were less, or at least no more, ingenious. Pauthier records, in his "Chine Ancienne," that many of the inventions in art and science of the earliest Chinese dynasties are said by the native historians to have come from the direction of Thibet, which, in that case, must have enjoyed a priority of civilization. It is to be noted that Magadha, Asoka's seat of power, was in a part of India (Behar) not very distant from that elevated region. Had the system of hieroglyphics, attributed to Fou-Hi as its author, been common to the dwellers on both sides of the mountains, there would be ample time for the differentiation which would give the Hindoos the benefit of an alphabet long before Asoka, while leaving the Chinese at the stage of graphic progress which suited their genius and their speech.

Mr. Taylor, however, though he does not pronounce the indigenous origin of the Indian alphabet impossible, is rather inclined to trace it to a Semitic source, the derivation from which, he thinks, is rendered probable by the analogy of the repeated transmissions of the Semitic alphabet. "The two primitive Indian scripts," he concludes, "are manifestly based upon alphabets which had reached the Semitic stage of evolution, their partial notation of the medial vowels being non-alphabetic in its character, while the emphatic initial vowels are more fully expressed, as in early Semitic inscriptions." Some writers, while allowing this argument as regards the Indo-Bactrian, decline to accept it for the Asoka alphabet. If it is of Semitic origin, they challenge those who hold that view to tell by what channel it reached India. Mr. Taylor replies, though with hesitation, that it may have got there by sea from Arabia Felix, the trade between Yemen and India having flourished between the tenth and sixth centuries, B.C. The Indo-Bactrian alphabet, according to the same authority, was introduced soon after the Persian conquest of the Punjaub, in the beginning of the fifth century, B.C.

In the cuneiform inscriptions, so abundantly unearthed from the ruins of the ancient cities of Mesopotamia, we find evidences of a process similar to that which resulted in the complicated ideography of the Chinese. It is also worthy of note that, here too, we have to deal with the invention, not of an Aryan or Semitic, but of a Turanian or Allophylian race. In the material used, however, the Babylonian writing stands apart from all other systems. They took the clay that was ready to their hands, and thereon imprinted the wedge-like characters which Mr. James Nasmyth considers to have been first suggested by the mark made by a hard brick applied edgeways to a soft clay surface. The Semitic Assyrians adopted the system from their vanquished foes, and formed syllabaries out of the Accadian phonograms,—the adaptation being effected in part by the process known as acrology, by which the phonographic symbol was made to indicate the initial syllable of

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[1] India, etc. Lect. vii.

a word. The Proto-Medic tribes, whose tongue was Ural-Altaic, and the Proto-Armenians, who were of Aryan affinity, subsequently borrowed the Assyrian syllabaries, and the latter have left memorials of themselves in the monuments and inscriptions of Lake Van and its neighbourhood.[1]

To the same race belonged the Hittites, whose empire rose to considerable power, and who carried to Asia Minor the art and culture of Babylonia. Sculptures attesting their greatness are visible in Cappadocia, Lycaonia, Phrygia and Lydia. Their sway ended with the fall of Carchemish, B.C. 717. According to Professor Sayce, the Cypriote syllabary was derived from the Hittite hieroglyphics, though other authors dispute this view. The syllabary in question is of considerable interest "as an example of an independent graphic system, unrelated to the Semitic alphabet, which was rapidly advancing on the path of alphabetic evolution at the time when it became extinct."[2] Professor Sayce says that it was once in use throughout Asia Minor. Conservative Cyprus alone retained it into historical times and has given to it the name by which it is known to the learned of the present day.[3] The characters, at least fifty-seven in number, were solved, after long resisting decipherment, by the genius of the late George Smith, the distinguished Assyrian scholar. Whether it was of Assyrian or of Hittite origin, it missed that tide which, "taken at the flood, leads on to fortune." Not to Babylon or Carchemish, but to Tyre and Sidon, was western civilization to be indebted for the boon of letters. But where did the Phœnicians receive the impulse which urged them to the alphabetic goal? Long before the mythic, yet in one sense, most real, Cadmus set forth in his eventful quest for Europa,[4] the inhabitants of the Nile valley had learned to express in symbols what they thought and said and saw and did. Thirty-five centuries ago, Mr. Taylor tells us, hieroglyphic writing was a venerable system of vast antiquity. Nay, even twenty-six centuries further back, the pyramid-builders were able to record in that way the glories of their reigns. Five hundred years still further into remote antiquity we may venture, confident that our search will not be in vain.[5] At that date, B.C. 4700, was erected by king Sent, of the second dynasty, a memorial to his grandson Shera, now in the Ashmolean Museum, Oxford, which, though the oldest written record in existence, is of even greater interest for the long list of unknown predecessors that it implies. Nor is that all. Far off as it lies in the past, it already contains a germ of promise which later ingenuity was to fructify into the supreme blessing of a true alphabet. Of the symbols that stand for Sent's own name, within the distinctive cartouche, the hand and the waterline are recognized as the very forefathers of two of our most important letters, *N* and *D*. Taylor maintains indeed, that "from the times of the earliest known monuments, the hieroglyphic writers possessed a sufficient number of true letters to enable them to write alphabetically."[6]

A strong, united voice of tradition attributed to Phœnicia the honour of having bes-

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[1] Taylor's Alphabet, i. 46, 47; Sayce's Ancient Empires of the East, p. 213. The Persians developed the cuneiform into a system which deserved to be ranked as an alphabet; but, after being in vogue for about a century, it was superseded by the Semitic characters.

[2] Taylor's Alphabet, ii. 117.

[3] "The Inscriptions found at Hissarlik," by Prof. Sayce, in Appendix to Schliemann's Ilios.

[4] If the conjectures of some writers be correct, that quest was simply the East (Kedem) seeking the West (Ereb.)

[5] The Alphabet, i. 56.

[6] *Ibid.*, i. 68.

towed the alphabet on the Greeks. With less assurance, the Phœnicians were said to have obtained the privilege from Egypt. "Primi per figuras animalium," writes Tacitus,[1] "Ægyptii sensus mentis effingebant, (ea antiquissima monumenta memoriæ humanæ impressa saxis cernuntur,) et literarum semet inventores perhibent; inde Phœnicas, quia mari præpollebant, intulisse Græciæ, gloriamque adeptos, tanquam reppererint quæ acceperant." But Tacitus hardly does justice to the Phœnicians, when he represents them as merely handing on what they had received. If, indeed, (for that point has first to be settled) it was the Egyptian system of writing that the Phœnicians had adopted into their *Aleph-Beth*, which the Greeks in turn were to further modify into their *Alpha-Beta*, the praise of inventors, and not merely of common carriers, is their due. What they gave to the Greeks was something quite different from what the Egyptians had to give them. If Egypt gave them the hint, they made such excellent use of it that it is not beyond their deserts to honour them as original inventors, as their representative, Cadmus, has for ages been honoured. What is the evidence, in the first place, that they made the Egytian symbols even their model?

"The two alphabets," says Isaac Taylor, "agree neither as to the number, the order, the manner, nor the forms of the respective letters. Till a very recent period these difficulties led scholars of repute to the conclusion that classical tradition was at fault in asserting that the Phœnician letters were originally obtained from Egypt." In the fifth edition of his "Histoire Générale et Système Comparé des Langues Sémitiques," Ernest Renan wrote that "the origin of writing, with the Semites, as with all other peoples, was hidden in profound night. Then, after asking whether it was derived from the hieroglyphics of Egypt or from the cuneiform characters of Assyria, or from both, or whether its phonetic stage was reached through the Hyksos, he thus proceeds: "To affirm that the Semitic alphabet, such as we know it, is really a creation of the Semites, it is not necessary to insist that the Semites, in creating it, did not avail themselves of any previous experiment." And in a note he adds: "It has long been observed that in the ancient Semitic alphabets the form of each letter represents what the name of the letter signifies. But it may be that these names were given to characters already formed, and indicate nothing as to their formation. The resemblances of name and form, which have been shown to exist between certain Semitic and Egyptian characters, are more significant. But we must wait till M. de Rougé has published his researches on this subject in a complete form."[2] The distinguished scholar, to whom M. Renan so hopefully refers, died before the purposed revision of his work could be carried out. But fifteen years later, his son, M. Jacques de Rougé, worthily performed the task, and the world was placed in possession of information which left little doubt as to the debt of Phœnicia and therefore of all western civilization to the ancient Egyptians. Hitherto, the comparison had been fruitlessly made between the Phœnician characters and the hieroglyphics. While those symbols were devoted to monumental and sacred uses, there had been, at an early date, developed out of them a series of cursive characters which were employed for secular and literary purposes. Until recently, the hieratic of the New Empire and the demotic derived from it were the only cursive forms known. But exploration having opportunely brought to light specimens of a very much older form of hieratic, which arose during the early empire

[1] Annal. xi. ch. 14.

[2] Hist. des Langues Sémitiques, p. 114, footnote.

and was in vogue during the Semitic conquest of the Delta, M. de Rougé was led to trace the Semitic alphabet to that source. The careful collation of both sets of characters, with special attention to the transliteration of Egyptian words in the Bible, and still more, to the Egyptian transliteration of Syrian geographical names, conducted the inquirer to the welcome conclusion that every Semitic letter could be easily deduced from its hieratic prototype. The documents of which M. de Rougé availed himself in his investigation were not accessible to students of a much earlier date. One of them, the *Papyrus Prisse*, "the most ancient of all books," was obtained at Thebes by M. Prisse d'Avennes, by whom it was presented to the Bibliothèque Nationale at Paris, and published in fac-simile in 1847. It purports to be a copy of a work written by Prince Ptah-Hotep, who lived in the reign of Assa, a king of the fifth dynasty. "By the curious irony of chance," writes Mr. Taylor, "this primeval treasure—this stray waif which has thus floated down to us from the days of the very childhood of the world—has for its subject the moralizing of an aged sage, who deplores the deterioration of his age, and laments the good old times which had passed away."[1] The *Papyrus Prisse* furnished the best type of hieratic writing, as adapted to literary and commercial purposes in the early Empire; and the Semitic characters with which that writing was minutely compared were those of another venerable, but much later, monument of the past—the famous Moabite Stone discovered in 1868. The conclusions worked out with such conscientious assiduity by MM. de Rougé, father and son, have the sanction of a number of distinguished names. But while the hypothesis is sustained by the authority of Professors Max Müller, Sayce, Peile and Mahaffy, among British, and Lenormant, Euting, Maspero, Fabretti and Ebers, among foreign, philologists, the objectors are also men of mark, including Professors Robertson Smith, R. Stuart Poole and Lagarde. Their adverse criticism has been firmly and ably answered by Isaac Taylor.[2]

Before taking leave of the old world, it may be interesting to show, with as much brevity as is consistent with clearness, the connection between the alphabets of to-day and those whose start in life we have been considering. If the argument of de Rougé be well-founded, and Mr. Taylor's genealogy be correct, all the alphabets in use to-day on the old continent, with the exception of the Chinese and Japanese, which are not alphabets in our sense, are descended from the hieratic, and, through it, from the immemorial hieroglyphics of Egypt. The Semitic bore two children, the Phœnician and the South Semitic. From the latter, through the Joktanite, came the Sabean, the Thamudite (Safa) and the Omanite (Yemen). The Sabean begat the Himyaritic, which begat the Ethiopic, which again begat the Amharic. The Omanite (if Mr. Taylor's view, already stated, as to the origin of the Indian alphabet be accepted) bore the Old Indian or Asoka, which had three sturdy sons, the Pali, the Nagari and the Dravidian. The Pali became the father of the Burmese, Siamese, Javanese, Singalese, and Corean; the Nagari, of the Tibetan, Gujarati, Kashmiri, Marathi, and Bengali; the Dravidian, of the Malayan, the Telugu, the Kanarese, the Tamil and the Grantha. The Phœnician bore three children, the Sidonian, the Tyrian, and the Cadmean. The Sidonian bore the Punic and the Aramean. The Punic begat the Iberian and the Numidian. The Aramean had a family of seven: the Herodian, Palmyrene, Estranghelo, Hauranitic, Nabathean, Iranian and Bactrian. The child and grandchild of

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[1] The Alphabet, i. 95, 96.

[2] *Ibid.*, i. 70–147.

the Herodian were the Square Hebrew and the Rabbinic. The Estranghelo gave birth to the Melchite, Nestorian, Jacobite and Mendaite. The Nestorian bore the Uigur—which in turn bore the Mongolian, Kalmuk and Manchu—the Syro-Chaldee and the Karshuni. The Nabathean had for offspring the Kufic and the Neshki ; and the Neshki had an important family, the Arabic, Turkish, Persian and Hindustani. The Iranian begat the Pehlvi—which begat the Parsi—and the Mesrobian, which bore the Armenian and Georgian. The Tyrian had two sons, the Israelite and the Moabite, the former having as lineal descendants, the Asmonean, Old Samaritan and Modern Samaritan. The Cadmean bore the Carian, the Lycian, the Italic and Hellenic, and of the Hellenic were born the Runic[1] and the Greek, the latter, in turn, bearing the Coptic, Mœso-Gothic, the Cursive Greek—with its progeny, the Greek Minuscule, Romaic, Albanian and Glagolitic—and the Cyrillic—with its progeny, the Servian, Wallachian and Russian. The Italic bore the Messapian, Oscan, Faliscan, Umbrian, Etruscan and Latin, which last had for daughter the Uncial Latin, and for grandchildren, the Italic type, the Roman type, the German script and the English script. Such is the affiliation of the great Semitic family of alphabets, as tabulated by Mr. Taylor.

We have already seen that some of the American nations, when they first became known to Europeans, were not destitute of the means of giving their thoughts a permanent shape. The *quipu* or knotted cord in Peru, and the wampum of the North American Indians, were rude mnemonic contrivances, which only a special training and long acquaintance could turn to useful account. A higher stage was reached in the picture-writing of the Aztecs. Clumsy as it was, Prescott says, it seems to have been adequate to the demands of the nation in its imperfect state of civilization. As the same writer points out, it was, like the *quipus* and wampum belts, valuable chiefly when used in association with oral tradition. The hieroglyphics, engraved on tablets and inserted into buildings in the ruined cities of Yucatan and Central America, are remarkable for the beauty of the workmanship; but attempts to decipher them have not proved very successful. The Aztec picture-writing, though less advanced, is also extremely interesting from the ingenuity with which it was adapted to historical, mnemonic, and educational purposes. The Mayas alone of the American peoples have been credited with an alphabet. Of this I shall presently give some account. Both the Aztecs and the Mayas had books, but the most of them were burned by the Spaniards on the ground that they were idolatrous. Four Maya manuscripts, have, however, been saved from the threatened holocaust, the *Codex Peresianus*, the *Dresden Codex*, the *Codex Troano* and the *Codex Cortesianus.* The two last, according to M. de Rosny, belong to the same original document. In 1863, Abbé Brasseur de Bourbourg discovered in the archives of the Royal Academy of Madrid a work which, he announced, contained a key to the Maya symbols. Hitherto the students of American archæology had not dreamed that the nations, in which they were interested, possessed anything like an alphabet in the received sense of the term. But Bishop Landa, the author of the "Relacion de las Cosas de Yucatan," brought to light by the indefatigable Abbé, suggested the notion that the Maya hieroglyphics were used as alphabetic characters. The publication of Landa's alphabet naturally, therefore,

[1] Mr. Taylor's theory is that the northern runes were obtained from the Hellenic Colonies of the Euxine by the commercial route of the Borysthenes.

caused intense excitement in the antiquarian world. It was now taken for granted that the inscriptions which had heretofore baffled the ingenuity and patience of the most skilful palæographist, could be readily interpreted, and that a flood of welcome light would be shed on the origin and history of the Central American nations. Alas! the hope was destined to be disappointed. The key would not open the door to the mystery, which must remain a mystery still. Some of the ardent believers in Landa's alphabet were, indeed, said to have used it to good account. By means of it "Mr. Bollaert obtained encouraging results from hieroglyphics figured in Stephens's works." But the author[1] who gives this testimony, virtually unsays it a little after. He has more faith in a distinguished French investigator, M. de Rosny, the learned editor of the *Codex Cortesianus.* "M. de Rosny," says Mr. Strong, "in his able essays on the decipherment of the hieratic writings of Central America has undertaken the solution of this interesting and perplexing problem in a scientific manner, and we have the fullest confidence that his system, constructed on Landa's key, will open to us the books and inscriptions of the Mayas." Others discredited the great discovery of M. de Bourbourg from the first, and among these none have denied its alphabetic character more vigorously than Dr. P. Valentini. In a paper, read before the American Antiquarian Society and afterwards published in pamphlet form, he says: "My study of the writers on the Spanish Conquest gave me the firmest conviction that the Central American hieroglyphics stand for objects and nothing else. From the day that I obtained a copy of Landa's work (which was in the spring of 1871, in which year, after a prolonged sojourn in Central America, I had come to New York), the impression was rooted in my mind that the believers in this alphabetic table were laboring under a manifest delusion. This impression grew stronger when watching the movements made in the phonetical deciphering, I noticed that the specimens offered to the public were only so many witnesses of the valueless character of the so-called phonetic key." Dr. Valentini gives quotations from the historians of the Conquest to shew that in no case was mention made of alphabetic writing as a native possession. The expressions used are invariably signs, figures, characters or symbols. Everything, in Dr. Valentini's opinion, goes to prove that an alphabetic system was unthought of as pertaining to any of the American nations, what was said of the Nahuas of Mexico being equally applicable to the Mayas of Yucatan. Landa's is the only authority that has ever been adduced for the contrary hypothesis, but even in Landa's work there is no passage "in which he positively states that the natives in the period of their paganism used an alphabet composed of symbolic letters." It is his meagre explanation of the plan, which he adopted to teach his converts the verities of the Christian faith, that caused the grave misunderstanding. That plan was, in fine, a mnemonic device not new to missionaries situated as Landa was, and consisted in the choice of certain objects of which the names in the Maya tongue suggested the letters of the alphabet. Repeating the sound *a*, for instance, Landa would ask one of his disciples to draw a rough picture of the object which the sound called up in his mind. After thinking a moment, one of the pupils would make a rude outline of a tortoise, saying, as he showed it to his teacher, "*ac.*" Seeking a better representation of the sound, Landa would urge him to a second trial, and his obedient scholar would put down the counterfeit presentment of a curved knife, *ach.* A third experiment would elicit the very echo of the

[1] Strong's North Americans of Antiquity, pp. 425, 426.

letter, *a*, the Maya word for "leg." In this way the bishop would proceed till he had impressed upon his hearers the value of every sound in the Spanish alphabet. Such, according to Dr. Valentini, is the true story of the genesis of the famous Landa alphabet. He does not hesitate to pronounce it, without any reproach, a Spanish fabrication; and, perhaps, the strongest ground for the charge is the order of the alphabet itself. It certainly would be an extraordinary coincidence to find a Central American alphabet following exactly, in the sequence of the characters, the arrangement of our *A*, *B*, *C*. Right or wrong, Dr. Valentini's theory is most ingeniously worked out. Except in three instances, *I*, *M*, and *O*, he has succeeded in identifying to his satisfaction the objects indicated by the Maya symbols. Though his pamphlet is not a direct indictment of the good faith of the discoverer, he expresses his surprise that Abbé Brasseur de Bourbourg should have omitted to give such detailed information as to the date, place and circumstances of his discovery as might reasonably have been expected to accompany so important an announcement.

But if Dr. Valentini is sceptical, there are others, as already intimated, on whose eager faith no shadow of doubt has been allowed to rest. The Rev. Isaac Taylor, though he does not give Bishop Landa's scheme in his work, "The Alphabet," writes of it as deserving of alphabetic honours. "It appears," he says, "that, in addition to a certain number of syllabic signs and a few ideograms, the Mayas employed twenty-seven characters which must be admitted to be alphabetic." But, after some words of praise to a civilized people who had invented a system of writing superior to that of either the Assyrians or the Chinese, he adds: "The systems of picture-writing which were invented and developed by the tribes of Central America, are, however, so obscure, and so little is known about their history, that they must be regarded rather as literary curiosities than as affording materials for enabling us to arrive at any general conclusions as to the nature of the early stages of the development of the graphic art." [1]

Mr. Ignatius Donnelly, in his "Atlantis," endeavours to trace the alphabets of the eastern hemisphere, through the Atlanteans, to the Maya symbols, devoting much learning to the hopeless task. Whether it be an alphabet or not, one thing is unhappily certain, that the discovery which drew from Brasseur de Bourbourg the rapturous cry, "Eureka," has hitherto, as Dr. Valentini insists, and even M. de Rosny has been forced to concede, proved of little service in the decipherment of the Maya documents. In a review of M. de Rosny's edition of the *Codex Cortesianus*, in *Science* (April 11, 1884), Mr. Cyrus Thomas wrote as follows: "That Rosny is largely influenced in his interpretation of characters by Landa's alphabet and the names of the days, is quite perceptible in this vocabulary. I am satisfied that no decided progress can be made in deciphering these aboriginal documents until we break loose from these trammels and use as a key the few characters which can be satisfactorily determined otherwise." [2]

If the so-called "Landa alphabet" be nothing more than what Dr. Valentini represents it to be, there is nothing else on which palæographists can fall back to support the theory that Americans had developed alphabetic writing. The numerous finds which have

[1] The Alphabet, i. 24, 25.

[2] At the first meeting of the Congrès des Américanistes, at Nancy, Señor Gavino Pacheco-Zegarra read a paper, in which he advocated the adoption of a phonetic alphabet of his own elaboration, instead of the Quichua language of Peru which, he says, is still spoken by 1,500,000 people.

exercised epigraphic skill from the Dighton Rock to the Davenport Tablet, whatever else they may indicate, cannot be accepted as evidence that any of the North Americans of antiquity had a graphic system of their own. On this point the statement made by Messrs. Nott and Gliddon nearly thirty years ago, that "no trace of an alphabet existed at the conquest of the continent," is still as true as ever. "If the Mound-builders had a written language," writes Mr. T. P. McLean, "they were in possession of abundant means to have perpetuated it. Numerous plates of copper and polished slate were at their command, and if they possessed this art, letters would certainly have been engraved upon them, and uniform characters would have been found from the great lakes to the Gulf."[1] This being the case, it is unnecessary to recount the many attempts that have been made to credit them with such an acquisition. In some cases of alleged discovery of inscribed tablets, as in that of the Newark stone of David Wyrick, fraud has been clearly proved. In others, the alleged lettered inscriptions, though accepted by many as genuine, owing to the reputation of the *soi-disant* finders, have only resulted in mystification and waste of time. Even the markings on the famous Dighton Rock, of which the eventful epigraphic history covers more than two centuries, could suggest to so experienced a palæographist as Dr. Daniel Wilson, nothing but a "confused and indistinct scrawl."[2] Mons. G. Gravier de Montjau, in a paper read before the Congrès des Américanistes at Nancy, in 1875, in referring to the large number of such rock memorials scattered over the continent, expressed regret that they were not faithfully copied by skilful antiquaries. The French scholar had in his mind the saving from destruction, through ignorance or indifference, of valuable relics of the past; but there is another reason why the transcription or reproduction of such alleged memorials should be entrusted only to men of learning and honesty. With truthful copies before them, palæographic students would, at least, know the real character of the problem which they were endeavoring to solve and would be saved the disappointment and vexation, of which some of them have been the victims, of wasting their analytic talents on unworthy objects. Such experience, however, has not been all in vain; for, although the trade in false curiosities and antiques has in recent years assumed extraordinary proportions (the demand, no doubt, among amateurs having stimulated, if not created, the supply), the knowledge of its existence has made earnest investigators more cautious than they would otherwise have been.

This notice of the world's alphabets would be incomplete without some reference to those which have been elaborated for one purpose or other in modern times. In the first half of the last century the famous impostor, George Psalmanazar, invented an alphabet for his pretended Formosan language, though he forgot to give names to his letters. Such a ruse for living on the learned public would be impossible to-day. What Psalmanazar did to maintain his personation of a converted heathen, several missionaries have done to carry on the work of conversion. Of the missions of the present century, one of the most successful is that which the American Baptist Society has carried on among the Karen tribes of Burmah. Finding no written characters in existence, the zealous agents of the Society invented an alphabet, modelled on the Burmese, and in that they have printed thousands of Bibles, tracts and school-books. In Africa and Polynesia, the same thing has been done again and again. Some of the missionary alphabets are more correctly

[1] The Mound-Builders, p. 122.

[2] Prehistoric Man, ii. 97.

described as syllabaries. The mode of writing in use in the Christian schools of the Chippewyans, Crees, and Eskimos, is, indeed, distinctly so named. The syllabaries in question which differ from each other only in slight details, are of the simplest kind. The Eskimo syllabarium, for instance, consists of eleven consonants, (*p, t, k, ch, m, n, s, l, y, v,* and *r*) and four vowels (*a* long, *a* short, *e* and *o*). The vowels are all represented by an isosceles triangle, about the size of any ordinary small capital, the differentiation being effected by the direction of the apex. With apex down, it stands for *a* long; with apex up, for *e*; to the right, for *o*; to the left, for *a* short. Each consonant has, in like manner, a symbol, which makes a syllable with *a*, short or long, *e* or *o*, according as it is placed. Marks of smaller size serve the purpose of finals. Several devotional and educational books have been printed in these characters, which, when associated on the page, bear a remote resemblance to some of the vernacular alphabets of India.

One American Indian has won the fame of a new-world Cadmus—the Cherokee, Sequoyah. This ingenious tribesman, sometimes called George Guess, was ignorant of any tongue but his own, until, seeing some text-books in a missionary school, and being informed that the characters represented the words of the English language, as he heard it spoken, he conceived the idea of framing a system of writing for his own people. He began by trying to invent a sign for each word; but, that plan being discarded as too cumbrous, he finally succeeded in forming, with endless pains, a syllabic alphabet of eighty-five characters, which has won the admiration of even civilized men. Sir John Lubbock says of this remarkable alphabet: "Sequoyah invented a system of letters, which, as far as the Cherokee language is concerned, is better than our own. Cherokee contains twelve consonants and six vowels, with a nasal sound, *mung*. Multiplying the twelve consonants by the six vowels, and adding the vowels which occur singly, he acquired seventy-seven characters, to which he added eight, representing the sounds, *s, ka, hna, nah, ta, te, ti, tla,* making altogether eighty-five characters. This alphabet, as already mentioned, is better than ours. The characters are, indeed, numerous, but when once learned, the pupil can read at once. It is said that a boy can read Cherokee, when thus expressed, in a few weeks, while, if ordinary letters are used, two years are required."[1]

Sequoyah would seem to have thus attained, by intuition, what the Spelling Reformers have for many years past been strenuously demanding—an alphabet corresponding with the articulate sounds of the people using it. Professor George Hermann von Meyer, in his "Organs of Speech," says that "our alphabet is nothing more than an arbitrary collection of letters, in which, on the one hand, several letters represent the same sound, and on the other, several sounds which exist as pure elements of speech are not represented at all by a special letter, but must be expressed by a combination of letters, while compound sounds, on the contrary, are given in a single letter." To remedy this defect, several schemes have been devised—the most celebrated and most successful being the Pitman system, generally associated with short-hand.

But the most ambitious and comprehensive of all alphabetical schemes is the Visible Speech of Dr. Melville Bell. "In this system," its author tells us, "no sound is arbitrarily represented, but each letter is *built up* of symbols which denote the organic positions and actions that produce the sound. The letters are thus physiological pictures, which inter-

[1] Origin of Civilization, Appendix.

pret themselves to those who have learned the meaning of the elementary symbols of which they are composed." Again he says: "The system of Visible Speech is the ready vehicle for a universal language, when that shall be evolved; but it is also immediately serviceable for the conveyance of the diverse utterances of every existing language. No matter what foreign words may be written in this universal character, they will be pronounced by readers in any country with absolute uniformity." According to Dr. Bell's method, there are four simple symbols for the vowels, "from the combinations of which every vowel in every language can be expressed to the eye, so as to be at once pronounced with exactitude by the reader." In like manner there are five elementary symbols for the consonants. All the elements of each class have one symbol in common—that of the vowels being a straight line, that of the consonants, a curve. From the synthesis of these symbols, which are simply directions for the action of the lips and tongue, any letter in the alphabet may be formed. Visible Speech was first made known to the world in the summer of 1867, and has been largely studied by philologists as "an exponent of linguistic phonetics." Before that date Mr. Alex. John Ellis had devoted much time to the same subject and his treatises are highly recommended by Professor Max Müller, in the fifth of his second series of "Lectures on the Science of Language," in which he discusses the claims of the physiological alphabet or alphabet of nature. The latest work on the subject is "The Organs of Speech and their Application in the Formation of Articulate Sounds," by Professor Meyer, of the University of Zurich, from which I have already quoted.

III.—*Sources of Early Canadian History.*

By GEORGE STEWART, JUN.

(Read May 28, 1885.)

The most conspicuous figure in the early history of French colonization in America is, beyond any doubt, Louis de Buade, Count of Palluau and Frontenac. He was twice governor of New France, and his administration covers two of the most romantic periods in the progress and career of the country. His mastery over the Indian nature has never been excelled. He understood the character of the savage well, and ruled him with the rod of iron, or the blandishments of the courtier, as occasion suited. Frontenac first came to Quebec, after a brilliant military experience in Europe, in 1672,—a matured man of fifty-two years of age, full of energy, zeal and enterprise. He continued in office from that date until 1682, when, owing to his quarrels with the clergy and his Intendant, and certain trading operations forbidden by the court, reaching the ear of the king, he was recalled to France, and Le Fèbvre de La Barre, a soldier of note, was appointed in his stead. De La Barre, however, did not reign long. His career proved disastrous in the extreme, and the miserable policy he pursued crippled the resources of the little colony, and lowered the prestige of France in the eyes of the Indians. The king recalled him in the third year of his governorship, and sent in his place the Marquis de Denonville, a pious colonel of dragoons, who arrived in Quebec in the autumn of 1685. De Denonville proved even a more incapable ruler than his predecessor, and he had not been long in the country before he had brought it down to the very brink of ruin. One disaster followed quickly on another, and the Massacre of Lachine, in 1689, was the culminating blot on the troublous administration of the weak and impotent marquis. It was then that all eyes again turned to Frontenac, now in his seventieth year. The old warrior was forgiven his past follies by Louis, and once more took up the governorship of the struggling settlement of La Nouvelle France. He reached Quebec in the autumn of 1689, and was received with fireworks and jubilations. He asserted his old power over the Indians, and soon had them under subjection. His memorable defeat of Phips, and numerous small victories over other enemies of his country, together with his general conduct of affairs lent lustre to his somewhat eventful reign. He died at Quebec in 1698, in the seventy-eighth year of his age, sincerely mourned by all New France.

The materials from which this brief story is drawn are copious and rich. A large portion of the manuscript sources may be found in the invaluable collection of papers relating to New France, in the Archives of the Marine and Colonies, the Archives Nationales, and the Bibliothèque Nationale in Paris; and in the office of the Provincial Registrar at Quebec. The Archives of New York, Massachusetts, and Canada, have made extensive transcripts from these documents as follows:—

1. "Correspondance Officiele," first series, Vols. I—V. There are transcripts from the Paris documents copied in France for the State of New York, and translations of all of them are in the ninth and tenth volumes of the "Documents relating to the Colonial History of the State of New York."

2. "Correspondance Officiele," second series, Vols. II, IV—VIII. These papers exist in manuscript, and have not been translated into English. There are copies in the Library of Parliament, Ottawa, and in the Archives Office of the Quebec Government.

3. A collection of papers made by an agent of Massachusetts at Paris, Mr. Ben. Perley-Poore, in 1844. They were copied afterward in Boston on an order from the Quebec Government, and are in the keeping of the Registrar at Quebec. These documents were published in four large quartos by the Quebec Government, in 1883–85, under the general title "Collection de Manuscrits." Mr. Perley-Poore's copies, comprising ten large volumes, are to be found in the Archives' Rooms of the State House, Boston. These papers are very valuable as far as they go, but the copyist left many gaps unfilled, and returned to Massachusetts without completing his work.

The original Register and Proceedings of Council, in several volumes, remain in very fair condition in the Archives of the Quebec Government. The first, a folio bound in calf and indexed, bears two titles, the first of which is, "Régistre des Insinuations du Conseil Supérieur de 1663 à 1682," pp. 96. It begins with the king's edict creating the Superior Council, dated April 1st, 1663, and ends with the "Procès Verbal" of the Superior Council concerning the "Redaction" of the "Code Civil," or Ordinance of Louis, April 14th, 1667.

The second title is, "Jugements et Délibérations du Conseil Souverain de la Nouvelle France, 1663 à 1676," pp. 281. It begins with an *arrêt* of the Superior Council ordering the registration of the king's edict of April 1st, 1663, creating the Superior Council for New France, to be held at Quebec; and ends with an interlocutory judgment, dated December 19th, 1676, upon a petition of François Noir Roland, complaining of his curate for refusing him absolution. This book or register is authenticated by the certificate of the governor, Comte de Frontenac, on the first page, as follows: "Le Présent Régistre du Conseil Souverain contenant trois cents soixante et seize feuillets a été ce jour paraphé *ne varietur* par premier et dernier, par nous Louis de Buade de Frontenac Chevallier Comte de Palluau, Conseiller du Roy en ses Conseils, Gouverneur et Intendant Général pour sa Majesté, en la Nouvelle France, Québec, le quinzième Janvier mille six cents soixante et quinze.—Frontenac." The entries in general throughout this end of the book are authenticated by the governor, bishop, intendant, councillors, or clerk of the Council; and the last, or two hundred and eighty-first leaf, is signed by Duchesneau, intendant, and by Dupont, member of the Council. Its general contents consist of a variety of orders, regulations, ordinances, judgments, civil and criminal, of the Superior Council, licitations, and adjudications of Crown estates, representations to the king and his ministers upon various subjects. There are the four following volumes of this Register in the Archives at Quebec, bearing the dates, 1677 to 1680, 1681, 1681 to 1687, and 1688 to 1693, respectively. Each of these contains interesting details of Council proceedings during the first administration of Frontenac, the time of de La Barre and de Denonville, and during Frontenac's second term.

The "Edits et Ordonnances," Vol. III, contains copies of the Commissions of Frontenac, La Barre and de Denonville.

For particulars concerning the youth of Frontenac, his family and marriage, see Parkman's Appendix, where, among other sources, are named the Journal of Jean Héroard, physician to the Court, part of which is cited in "Le Correspondant" of Paris for 1873; Pinard, "Chronologie Historique-Militaire;" "Les Mémoires de Sully;" "Table de la Gazette de France;" "Mémoires de Philippe Hurault" (in Petitot); Jal, "Dictionnaire Critique, Biographique, et d' Histoire," article, "Frontenac;" "Historiettes de Tallemant des Réaux," IX, (ed. Monmerqué); "Mémoires de Mademoiselle de Montpensier," Vols. I–III; and "Mémoires du Duc de Saint Simon." Frontenac's will is printed in the "Magazine of American History," June, 1883, p. 465, New York.

At Frontenac's death we have an "Oraison funèbre du Comte de Frontenac, par le Père Olivier Goyer," preached from the text, *In multitudine videbor bonus et in bello fortis.* A copy of this eulogy, containing a running commentary on its sentiments strongly adverse to the views of the preacher, is preserved in the Seminary of Quebec. These comments, selections from which will be found in Parkman's "Count Frontenac and New France under Louis XIV," pp. 431-434, are, Abbé Casgrain informs me, from the caustic pen of Abbé Charles Glandelet, who came to Canada in 1675, and laboured for half a century in the Seminary.

The list of printed books relating to the period under consideration is very long, but few of these writings are entirely trustworthy as historical authorities,—prejudice and partisanship characterizing them for the most part. The contests of the day developed bitter antagonisms, and it was not easy at the time to withstand their influences. When we investigate the writings of these contemporaries, we find a remarkable lack of unity and sympathy prevailing, and this often extends to matters of trifling import. Unsatisfactory as chronicles as these books are, they are valuable as expressions of current partisan feeling, and in the latter form they frequently serve to throw light on all transactions. Foremost among these early narratives is the "Premier Établissement de la Foy dans la Nouvelle France" of Father Le Clercq. This work, it is said, was written under the eye of Frontenac himself. Certainly it is highly coloured, and presents the Recollet side in a strong and bold light. Bacqueville de La Potherie's "Histoire de l'Amerique Septentrionale depuis 1534 jusqu'à 1701," (Paris, 1722, four volumes,) is an exceedingly respectable authority, often quoted, and particularly useful for the light which it throws on the relations of Frontenac and de Callières. It is also held in high esteem as a contribution upon the condition of the Indians at that time. Charlevoix describes it as containing "undigested and ill-written material on a good portion of Canadian history."

The works of Hennepin, La Hontan, Tonti, and Marquette may be included among the principal early narratives which are worth consulting by the student. With the help of official and other contemporary documents, these writings may, in the main, satisfy the mind.

The "Histoire du Canada," by Abbé Belmont, Superior of the Seminary of Montreal during 1713 and 1724, is a short history of affairs from 1608 to 1700. The Literary and Historical Society of Quebec printed, about 1840, in their "Collection de Memoires," a small edition of the work from a manuscript copy in the Bibliothèque Nationale of Paris. This essay is generally accurate, and the views expressed are evidently the result of careful consideration.

The general history of the administrations of Frontenac, de La Barre, and de Denon-

ville is exhaustively treated by Father François Xavier de Charlevoix in his "Histoire et Description Générale de la Nouvelle France, avec le Journal Historique d'un Voyage fait par l'ordre du Roi dans l'Amérique Septentrionale," which was issued at Paris in 1744. This work is the first in point of importance and value, and sets forth the Jesuit side of the story ably and well. Shea, who edited an edition of the book, says: "Access to State Papers and the archives of the religious order to which he belonged, experience and skill as a practised writer, a clear head and an ability to analyze, arrange, and describe, fitted him for his work." On the other hand, Parkman often speaks of Charlevoix's "usual carelessness." In 1744 there were two editions of this history published, one in three volumes quarto, and the other in six volumes of small size, with the plates folded. "Heriot," says Justin Winsor, "published an abridged translation of Charlevoix in 1804, but the English reader and the student of Canadian history owes a great deal to the version and annotations of Dr. Shea, which this scholar printed in New York in six sumptuous volumes in 1866-72." Charlevoix, of course, gives great prominence to the ecclesiastical side of the subject. He is not altogether unfair to Frontenac, though the Recollets do not fare so well at his hands.

Abbé La Tour, not a very trustworthy authority, wrote "Memoirs sur la vie de M. de Laval, premier Evêque de Quebec" in 1761. Only one volume appeared, though the scope of the work demanded two. The unfair manner in which Bishop St. Vallier was treated in the manuscript of the second volume, led the worthy prelate's family to interpose objections to the publication of the matter, and it was not published. Frontenac is bitterly assailed in the first volume, his faults are greatly magnified, and very serious charges are preferred against him.

A useful work, which demands notice in the consideration of this period, is "L'Histoire de l'Hôtel Dieu de Québec, de 1639 à 1716," by the Rev. Mother Françoise Juchereau de St. Ignace, printed in Paris in 1751. It contains many facts and incidents, and is especially rich in details concerning the missionary activity of the time, and on the attempt made by the clergy to evangelize the savages. A supplementary work, prepared with great care and thoroughness from original documents, and bearing the same title, has been written by Abbé H. R. Casgrain. It is brought down to 1840, and was published at Quebec in 1878.

In the third series of "Historical Documents," published under the auspices of the Literary and Historical Society of Quebec in 1871, is a paper entitled "Recueil de ce qui s'est passé en Canada au sujet de la guerre, tant des Anglais que des Iroquois, depuis l'année 1682." It contains a full account of the Lachine massacre from the pen of an eye-witness. The author accompanied Subercase to the scene.

In a collection entitled "Bibliotheca Americana: Collection d'ouvrages inédits ou rares sur l'Amérique," with the imprint of Leipsic and Paris, appeared the "Mémoire sur les Mœurs, Coustumes, et Réligions des Sauvages de l'Amérique Septentrionale, par Nicolas Perrot, publié pour la première fois par le R. P. Tailhan, de la Compagnie de Jésus, 1864." Charlevoix, La Potherie, Abbé Ferland and other writers on early Canadian history attach considerable importance to this memoir. It will be found often quoted in their narratives. Harrisse (No. 833) says that this work seems to have been written day by day from 1665 to the death of Perrot. Colden gives a part of the narrative in his "History of the Five Indian Nations," London, 1747.

Approaching our own time, we have François Xavier Garneau's "Histoire du Canada," the accepted French Canadian authority. He began writing his work in 1840, and published the first volume in Quebec, in 1845, the second in 1846, and the third, treating of events down to 1792, in 1848. A new edition, revised and corrected, and brought down to 1840, appeared at Montreal from John Lovell's press, in 1852, and a third edition at Quebec in 1859. In 1882, the fourth edition, edited by his son, Alfred Garneau, the author of "Les Seigneurs de Frontenac," appeared at Montreal. This edition is enriched by a biography of the historian by the Hon. P. J. O. Chauveau, and a poem by Louis Honore Fréchette. The English reader is cautioned against Bell's so-called translation of Garneau's History, which contains many unwarrantable liberties with the text.

The ecclesiastical history of Canada is particulary illustrated by Abbé J. B. A. Ferland in his "Cours d'Histoire du Canada, 1534-1759," (Quebec, 1861 and 1865, two volumes). The author died while the second volume was passing through the press, and the completion of the publication devolved on Abbé Laverdière, one of the ripest scholars in the Canadian priesthood. Ferland had access to many documents of great interest, and his work shows judgment and a skilful handling of the rich store of materials within his reach.

The "Histoire de la Colonie Française en Canada," with maps, by Abbé Faillon, a Sulpitian priest of very great ability, was projected on an extensive plan. The author visited Canada on three separate occasions, spending several years in the country, and making the most of his opportunities in gathering his material, not only there, but from the archives of the Propaganda at Rome, and from the public offices in Paris. His work is of great and paramount value, but it must be read with a full perception of the author's intention to rear a monument to commemorate the labours and trials of the Sulpitians of Montreal. Three volumes only appeared, the first two in 1865, and the third in 1866. The death of M. Faillon at Paris, in 1871, prevented further publication, but he has left in manuscript enough prepared material to complete the work as far as the conquest of 1759-60. The book was published anonymously, according to the custom of the Congregation of St. Sulpice.

Two volumes of Francis Parkman's series of "France and England in North America" deal intimately with the period covered by the administrations of Frontenac, de La Barre and de Denonville. These are his "Count Frontenac and New France under Louis XIV," (Boston, 1877,) and his "La Salle, and the Discovery of the Great West" (Boston, 1879). The chief questioner of Parkman's views has been Abbé Casgrain, whose position is best understood from his "Une Paroisse Canadienne au XVII Siècle," Quebec, 1880. Of Mr. Parkman as an historian, there has been a wide recognition of a learning, that has neglected no resource; a research, which has proved fortunate in its results; a judgment, which, though Protestant, is fair and liberal; a critical perception, which in the conflict of testimony keeps him accurate and luminous; and a style, which has given his narrative the fascinations of a romance.

John Dennis wrote a tragedy, "Liberty Asserted," which was acted in London in 1704, in which Frontenac was made a character, together with an English governor and an Iroquois chief. Betterton acted in it. A romantic picture of the period is furnished in an amusing novel by M. Joseph Marmette, entitled "Francois de Bienville," in which Frontenac figures as one of the principal characters. Frontenac's expeditions against the

Iroquois were made the subject of a poem by Alfred B. Street, entitled "Frontenac, or the Atotarho of the Iroquois," London and New York, 1849.

Mr. T. P. Bedard, of the Archives Department, Quebec, has a paper in the "Annuaire de l'Institut Canadien," Nos. 7 and 8, 1880-81, which discusses the first and second administrations of the Count, and sheds some light on the social and political aspects of the country between 1672 and 1698, when Frontenac died.

Other printed books relating to the period considered in these pages, are Michael Bibaud's "Histoire du Canada sous la domination Française," published at Montreal in 1837, second edition in 1845; "The History of Canada from its first discovery in 1796," by William Smith, Quebec, 1815, "Histoire des Canadiens-Français, 1608-1880," by Benjamin Sulte, Montreal, 1882-83; and "Narrative and Critical History of America, with Bibliographical and Descriptive essays on its Historical sources and authorities," (eight volumes), edited by Justin Winsor, LL.D., 1885, Boston.

IV.—*The Adventures of Isaac Jogues, S. J.*

By W. H. WITHROW, D.D.

(Read May 27, 1885.)

In the early years of the seventeenth century a young lad might have been seen daily entering the Jesuit Seminary of the old historic town of Orleans. He was already an accomplished scholar, and might have won a distinguished reputation had he turned his attention to the cultivation of letters. But a nobler ambition possessed the soul of Isaac Jogues—a name destined to be illustrious in the annals of Christian martyrdom. His constitutional timidity shrank from the jostling conflict of life. His sensitive conscience recoiled from its sordid aims. His religious susceptibilities yearned for higher duties and purer enjoyments. He resolved to devote himself in youthful consecration to a religious life. He therefore sought admission to the Order of Jesus, and after a singularly devout novitiate assumed the irrevocable vows. But even the most ascetic discipline failed to satisfy the sense of duty of the young neophyte. He longed to devote himself to missionary labour, the especial vocation of his order.

All eyes were then turned to the vast and mysterious regions of the West, where was waged the strenuous conflict between Christianity and paganism. The Annual Relations[1] of the Jesuit Fathers kindled a fire of enthusiasm in many a pious mind Burning to share these glorious toils, and, if need were, to suffer and to die, *ad majorem Dei gloriam*,[2] Jogues obtained leave to join the Canadian Mission.

On July 2nd, 1636, the young recruit arrived at Quebec. He forthwith set out, accompanied by Fathers Garnier and Chatelain to re-enforce the Huron Mission on the shores of the Georgian Bay. After incredible hardships and exposure during a journey of nine hundred miles by lake and river, over rugged portages and through arrowy rapids, toiling at the paddle by day and sleeping on the cold damp ground by night, they at length reached the forest mission, planted two years before by Fathers Brèbeuf and Daniel, and destined to be fertilized by their blood.

They were received with joy by the resident missionaries. "I prepared an entertainment of what we had," writes Le Mercier: "a few dry fish and a little meal. But for heart and mind was never better cheer. The joy we felt was like the happiness of the blessed on their entrance into Paradise." But worn out by their unwonted toil, exposure and hardship, the new-comers, one after another, fell ill of a wasting fever. The Mission House, says Mercier became an hospital; but they had no other physician than the paternal providence of God.

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[1] For forty years, 1632-1672, these Relations were annually published in Paris. They have been collected in three large 8vo. volumes, and published by the Canadian Government, and have been closely followed in the text. The quaint old French is followed *verbatim* in the footnotes.

[2] The motto of the Jesuit Order.

On their recovery, having overcome prejudice and won many converts to Christianity by their saintly ministrations to the sick and dying Hurons, smitten with the loathsome small-pox which decimated their tribes, a new mission was at length projected for the conversion of the Tobacco nation, a kindred people who were still pagan. "This mission," writes Lalemant, "has been the richest of all, since its crosses and sufferings have been the most abundant."[1] Jogues and Garnier set forth, with only their good angels for their guides,[2] to bear the Gospel to these unknown savages. Towards dusk on the second day they reached a pagan village, just in time to instruct and baptize an Indian woman, who, as they expressed it, awaited only their arrival to die to all her miseries.[3] Through the neighboring villages they sought out the sick and suffering—the scattered sheep of the Good Shepherd[4]—and sought to bring them to the true fold.

The whole country was full of evil reports against the missionaries. The children cried out, at the apparition of the black robed figures, that Famine and Pest were coming.[5] Others fled at their approach. They could scarce find shelter from the winter storms. They were driven from hut to hut, from town to town. They endured hunger, cold, rain and snow. They were menaced with almost every form of death. But Christian charity conquered savage hate, and a successful mission was planted.

In the following year, 1640, we find Jogues associated with Father Peron in charge of the mission-fortress of Ste. Marie on the shores of the Georgian Bay. But while a single pagan tribe was unvisited, the zeal of the missionaries knew no cessation. In 1641, therefore, Fathers Jogues and Raymbault went forth as the first envoys of Christendom to the far West. For seventeen days they glided over unknown waters till they reached the cataract which they named, in honour of their virgin patroness, the Sault Ste. Marie. Here they planted the cross and preached its glad message five years before Eliot addressed the Indians within six miles of Boston. Soon the Jesuits had taken possession of the whole continent from Cape Breton to the Rocky Mountains, from Hudson Bay to the Gulf of Mexico, save a narrow strip on the Atlantic coast; and over that vast region they left their footprints forever in the names of innumerable lakes, rivers, mountains and other great features of nature.

In the spring of 1642, Jogues was commanded by his Superior to visit Quebec, on the business of the mission in whose service he had spent six toilful years. The ubiquitous Iroquois were on the war-path, thirsting for French or Huron blood. In five and thirty days after leaving Ste. Marie, Jogues with his Hurons, worn with toil and travel, reached Quebec. Having in five days transacted their business, they began their return journey, without giving an hour to pleasure or repose.

There were forty persons in the party, four of them French—Jogues, two lay associates, Couture and Goupil, and another—the rest were Hurons. On August 2nd, the

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[1] Cette mission a esté la plus riche de toutes, puis que les croix et les souffrances y ont esté plus abondantes. Relations, 1640, p. 95.

[2] Prennant nos bons Anges pour guides. *Ibid.*

[3] Nous arriuasmes sans doute où Dieu nous conduisoit, pour le salut d'vne ame predestinée, que n'attendoit rien nostre venuë pour mourir à toutes ces misères. *Ibid.*

[4] Les brebis de Nostre Seigneur sont bien esgarées çà et là. *Ibid.*, p. 96.

[5] Tout ce pays est remply de mauuais bruits qui courent contre nous: les enfans nous voyant arriuer quelque part s'escrient que la famine et la maladie viennent. *Ibid.*, 1640, p. 96.

little flotilla had reached the upper end of Lake St. Peter, about seventy miles from Quebec. The advance guard observed Iroquois footprints on the shore; but, trusting to their assumed superiority in number to the enemy, they proceeded. Within half a league they fell into an ambuscade. Suddenly the shrill war-whoop rang out, a storm of bullets hurtled through the air, and a large Iroquois war-party appeared. The Hurons in the rear abandoned the canoes and took to the woods. Jogues himself found concealment in the dense thicket; but, seeing Goupil and some of the Hurons captives, he resolved not to abandon them. He knew the fate he must brave, but flight seemed horrible.[1] "I must suffer the fires of earth," he said, "to deliver these poor souls from the flames of hell. I must endure a temporary death to procure for them eternal life."[2]

Couture, who had made his escape, refused to abandon Jogues. He was about to surrender to the Iroquois when one of them levelled an arquebuse at his head. With the instinct of self-preservation Couture laid the savage dead at his feet. "The Iroquois, with the fury of demons," says Jogues, "leaped upon the hapless Frenchman. They stripped off his clothes, beat him with clubs, and gnawed his bleeding fingers in their savage rage." The savages, with an outburst of fury, attacked Jogues, beat him senseless, and as he recovered consciousness, lacerated his fingers, bruising and crushing them, he says, as between two stones, causing exquisite agony. Goupil they treated with similar ferocity.

The victors retreated by way of the Richelieu, Lake Champlain and Lake Horicon, now Lake George, to Mohawk River. On Lake Champlain they met another war-party of two hundred Iroquois on their way to Canada. The latter, ranging themselves in two lines, made the unhappy captives run the gauntlet between their ranks, exposed to a perfect hail of blows. Before Jogues had traversed half of that path of anguish and savage fury, as he called it, he fell overpowered upon the ground. They then tore open his yet raw wounds and seared his flesh with burning brands. "But these sufferings," he devoutly exclaims, "undertaken from love to God and for his glory, are full of joy and honour."

Upon the point where rose in aftertimes the fortress of Ticonderoga they landed, and made the painful portage through the woods to the beautiful Lake Horicon. Crossing its fair expanse, they again landed upon the future site of Fort William Henry and plunged once more into the wilderness. For four days Jogues staggered beneath a heavy load, faint with suffering, hunger, toil and loss of blood, his wounds fevered by the oppressive heat. A few berries, snatched by his mangled hand from the bushes as he passed, sustained his life. He urged René Goupil to escape. As for himself, he said, he would suffer any torments in order that he might administer the sacraments to his little flock amid human wolves. "I will die with you," replied the faithful creature, "but I will never leave you."[3]

Thirteen days after their capture the wretched prisoners reached the Iroquois villages on Mohawk River, probably near the site of Utica. They had again to undergo a storm of scourging with clubs or with iron rods procured by the Indians from the Dutch

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[1] La fuitte me sembloit horrible. Lalemant, *Ibid.*, 1647, p. 18.

[2] Il faut, disois-ie en mon cœur, que mon corps souffre le feu de la terre, pour deliurer ces pauures ames des flammes de l'Enfer; il faut qu'il meure d'vne mort passagere, pour leur procurer vne vie éternelle. *Ibid.*, pp. 18, 19.

[3] Ie mourray, dit-il, auec vous, ie ne vous sçaurois abandonner. *Ibid.*

at Fort Orange. As he traversed this "narrow road of Paradise,"[1] a true *via crucis* to the heroic confessor, Jogues consoled himself with the thought that he was walking in the footsteps of his Lord and Master. With mangled and bleeding bodies the victims entered "that Babylon," the Indian village. Jogues and his three white companions were made to mount naked, on a scaffold preparatory to further tortures. "We are made a spectacle unto the world, and to angels, and to men," exclaimed the pious Jesuit.[2]

At night they were led to the wigwams to be the sport of the savage brood of these human hyenas. They were laid on the ground, their limbs outstretched in the form of a St. Andrew's cross, and bound so tightly to four stakes that the cords cut to the bone. The youthful amateurs in torture placed burning coals on their naked bodies, exulting in the anguished efforts of their victims to shake them off. These atrocities were repeated for three days and three nights. "My God, what nights they were," exclaimed Jogues, in shuddering recollection of their agony; "I passed through fire and water for the love of God." From town to town the hapless victims were driven, to repeat the spectacle of torture. Jogues endured a "Gehenna of anguish," by being bound to a cross, his whole weight hanging on his wrists. Released from his agony he found opportunity to instruct some Huron captives just taken, and finding a few drops of water on an ear of green corn thrown him to eat, he baptized his new converts. He rejoiced that, though in bonds himself, the word of God was not bound.[3]

Three of the Hurons were burned. Couture was rescued from a similar fate, by adoption into an Iroquois family in the place of a relative who had been slain. Jogues and Goupil were appointed to death. They sought unceasingly to rescue little children from the doom of death eternal by the administration, by stealth or guile, of the waters of baptism, whereby, as they phrased it, dying infants were changed from little savages to little angels. Goupil was detected making the sign of the cross on a child's brow. "Kill that dog,"[4] exclaimed its superstitious grandsire to a young brave, "that sign brings naught but evil."

Goupil and Jogues were soon waylaid in the forest, whither they had retired for prayer, and Goupil was despatched by a blow of a tomahawk. Jogues expected to share his fate but was ordered back to the village. Wishing to pay the last sad rites of burial to the remains of his friend, Jogues sought them far and wide. At length he found the body in a deep ravine, stripped naked and half eaten by dogs. He covered it with stones to protect it from the prowling wolves. Next day he returned to bury it, but the swollen river or savage malice had removed the mangled remains. "Crouched by the pitiless stream," says a sympathetic narrator of the event, "he mingled his tears with its waters, and, in a voice broken with groans, chanted the service of the dead." In the early spring he found, lower down the stream, the bleaching skeleton of his friend, and gathering the gnawed bones as sacred relics, with reverence kissed them and hid them in a hollow tree, hoping if ever he should make his escape, to give them Christian burial.[5]

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[1] Chemin éstroit du Paradis. Relations.

[2] *Spectaculum facti sumus mundo et Angelis et hominibus.* *Ibid.*, p. 22. These were also the dying words of Gabriel Lalemant, as he and Brèbeuf burned at the stake in the Huron country a few years later.

[3] *Verbum Dei non est alligatum.* *Ibid.*, 1644, p. 74.

[4] Va t'en tuer ce chien! Lalemant, *Ibid.*, 1647, p. 25.

[5] Le Pere retire ses sacres despoüilles, les baise auec respect, les cache dans le creux d'vn arbre pour les transporter auec soy, si tant est qu'on le mist en liberté. Lalemant, *Ibid.*, 1647, p. 25.

After this Jogues' life hung by a single hair. He became the common servant, or rather the slave of the village—a hewer of wood, a bearer of burdens, a performer of the most severe and menial tasks. Half starved and half clad, his flesh was lacerated by briars, and he was gnawed to the bone by piercing cold. Amid all his tribulations Jogues found his only consolation in prayer. He remained sometimes eight or ten hours on his knees in the snow before a cross which he had carved upon a tree. These spiritual exercises he continued for forty days, without house, fire, or any covering but the vault of heaven or the boughs of trees.[1] His devotions being discovered, they became the cause of increased persecution. He was regarded as an accursed sorcerer. His prayers were a magical incantation, thwarting the skill of the hunter and the valour of the bravest warrior. He became the object of cruel indignity, the butt of brutal sport. With unwearied patience he sought to win his cruel tyrants to accept the doctrine of the cross, and found a compensation for all his toils in the occasional opportunity of baptizing, in the hour of death, some repentant savage. He nerved himself for his continued living-sacrifice by the noble words of St. Bernard, *Non immerito vitam ille sibi vindicat nostram qui pro nobis dedit et suam.*

Jogues became the drudge of the Indian women, themselves the slaves of their savage lords. Yet he nursed, with an iron patience and a golden charity,[2] the wretch who, at his capture, had so cruelly mangled his fingers, but who was now sick of a loathsome disease. Yet, the missionary's life was continually menaced. He was actually appointed to be sacrificed with horrid pagan rites, when a number of captured Huron prisoners offered more congenial victims. One of them Jogues baptized amid the flames under the pretence of giving her a drink of water. During his captivity he baptized in all some sixty souls. "That," he says, "is my only consolation."

Presents and the offer of a ransom for the missionary came from Canada; but, while accepting the gifts, his captors refused his release. Jogues wrote several letters, which he sent by friendly savages, to be attached to poles on the bank of the St. Lawrence, in the hope that his countrymen might find them. He also found means to warn the fort at Three Rivers of a menaced attack. As the result, the Iroquois were repulsed with loss. They returned breathing slaughter against Jogues. He know the danger he had incurred. "I foresaw my death," he wrote, "but it seemed sweet and welcome, since offered for the benefit and comfort of my countrymen.[3]

Jogues was, at this juncture, with a fishing party on the Hudson near the Dutch settlement of Rensselaerswyck or Fort Orange, a hamlet of about thirty houses, and a hundred inhabitants, on the site where Albany now stands. Here he learned that the enraged Iroquois, betrayed as they conceived by his letters, had resolved on his destruction. Van Curler, the chief factor of the Fort, urged him to fly from the menaced danger, and offered him passage in a sloop bound for Bordeaux or Rochelle. "My heart," writes the priest, "was perplexed at these words, doubting if it would not be more for the glory of God, that I should endure the fire and fury of these savages for the salvation of some

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[1] Il passoit les huit et dix heures en oraison, demeurant pour la pluspart du temps à genoux sur la neige, deuant vne croix qu'il auait luy-mesme dressée; il continua ses exercices quarant iours durant, sans maison, sans feu, sans autre abry que le Ciel et les bois. *Ibid.*, p. 29.

[2] Avec vne patience de fer et vne charité toute d'or. *Ibid.*, p. 31.

[3] Le preuoyois ma mort, mais elle me sembloit douce et agréable, employée pour le bien public et pour la consolation de nos François. *Ibid.*, 1643, p. 75.

soul."[1] He asked time for consideration. He spent the night in prayer, imploring that God would not leave him to chose for himself, but that He would give him light to know His most holy will, which above all things, he wished to follow, even to be burned at the stake.[2] After much deliberation he resolved to embrace the offered deliverance. He was to escape in the night, when a boat would be left for him on the shore. He slept in a barn with his Iroquois masters. Stealing out to reconnoitre, he was attacked and severely bitten by a savage dog. Suspicion was excited and increased vigilance observed by the Indians. He lay among his savage captors, tossing in an agony of pain and mental disquiet. God had shut up all his ways, he thought, *Concluserat vias meas*. Later in the night he escaped. But, alas! the boat was left by the ebbing tide high and dry on the shore. The dawn threatened to discover to the Iroquois what with somewhat bitter humour he calls his innocent larceny of himself.[3] He succeeded in launching the boat and escaping to the sloop. He lay hid for two days half stifled in the hold. He prayed that he might not, like Jonah, fly from the face of the Lord, but that, on the contrary, God would confound all his counsels which were not for His glory.[4]

The second night of his imprisonment the Dutch pastor, Megapolensis, came on board to say that the Iroquois, enraged at his escape, threatened to burn the village. "If because of me this tempest is arisen," said the priest in the words of the Hebrew prophet, "take me up and cast me forth into the sea." He would not save himself to the prejudice of the humblest man in the settlement.[5] He was put on shore again, and the vessel sailed without him. He knew that, if retaken, his death would be one of no ordinary torture. But, "Blessed be God for ever," he exclaims, "we are continually in the arms of His divine and ever adorable providence."

He was put in charge of a miserly old man, who purloined half the food provided for his prisoner, so that the good priest was nearly starved. He was hidden in a garret, part of which was used for storing goods for barter with the savages. Thither the old Dutchman incessantly brought his Indian customers, and through the gaping joints of the partition they might easily have discovered Jogues a thousand times if God had not, as he piously remarks, turned away their eyes.[6] To escape discovery he used to crouch for hours at a time in a constrained posture, which caused an agony of pain, behind some barrels. He was parched with thirst, well nigh suffocated with heat, and faint with hunger.

After six weeks of irksome confinement, an order came from the Governor of Manhattan—or Manate, as the good father writes it, now New York—to send him thither. His Iroquois captors received goods to the amount of about 300 livres by way of ransom. At Manhattan, Jogues was treated with the utmost respect and was provided by the Governor with new clothing. The straggling town of a few hundred houses, with its garrison of sixty soldiers, was even then a type of what it afterwards became. No less than sixteen different languages were spoken in the little metropolis.

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[1] Vimont. Relations, 1643, p. 76.

[2] Ie passay la nuict en prieres, suppliante beaucoup nostre Seigneur, qu'il ne me laissast point prendre de conclusion de moy-mesme, qu'il me donnast lumiere pour cognoistre sa tres-saincte volonté, qu'en tout et par tout ie la voulois suiure, iusques à estre bruslé à petit feu. Vimont. *Ibid.*, 1643, p. 76.

[3] Le larcin que ie faisois de moy-mesme, ie craignois qu'il ne me surprisent dans ce delit innocent. *Ibid.*, p. 78.

[4] *Infatuaret omnia consilia quæ non essent ad suam gloriam.* Vimont, *Ibid.*, 1643, p. 78.

[5] Ie n'avois iamais eu de volonté de me sauuer au preiudice du moindre homme de leur habitation. *Ibid.*

[6] Si Dieu n'eust détourné leurs yeux, ils m'auroient mille fois apperçu. Lalemant, *Ibid.*, 1647, p. 33.

Early in November, Jogues took passage in a small barque for Holland. He suffered much on the voyage. His bed on the deck or on a pile of ropes was often drenched by the waves. His food was scanty, his clothing light, the cold intense. After two months tossing on the sea, he reached Falmouth late in December. The sailors went ashore, leaving Jogues in charge of the vessel. During the night it was boarded and pillaged by a gang of land-sharks, one of whom, presenting a pistol at Jogues' head, robbed him of his clothing, the gift of his Dutch friends. Through the compassion of a French crew he got passage in a small collier to the Bretagne coast. On Christmas day, he was put ashore near Brest. No language could express his joy as on the anniversary of the Saviour's birth he knelt at the altar and partook of the Holy Sacrament.

On the morning of January 5th, 1644, he reached Rennes, and soon knocked at the door of the Jesuit College. The janitor, seeing a man in the garb of a beggar, refused him admission. Jogues asked for the Rector.

"He is robing for the Mass," was the reply.

"I have news from Canada," said Jogues.

The word was like the utterance of a spell. The Canadian Mission was dear to the heart of all France, especially to the Jesuits; and Jogues' name, immortalized by the account of his sufferings in the published Relations of the previous year, was on every lip.

The Rector immediately appeared. "Did you know Father Jogues?" he eagerly inquired.

"I knew him well," replied the seeming mendicant.

"Have the Iroquois massacred him? Is he still a captive, or is he slain?" exclaimed the Rector.

"He is at liberty, and I am he, Reverend Father," and he threw himself on his knees before the Superior of the college to receive his benediction.

The Rector embraced him and led him into the hall of convocation, and great was the rejoicing of the brethren at his return, "like a Lazarus risen from the dead."[1]

That day he wrote to his friend Lalemant, the Superior of the Canadian Missions, not without a touch of pious cynicism, "What joy, after having dwelt so long among savages, after having conversed with Calvinists, Lutherans, Anabaptists, and Puritans, to find myself among the servants of God in the Catholic Church! It is an earnest of the joys of Paradise when God shall gather the dispersed of Israel."[2]

From Rennes, Jogues was summoned to Paris to recount to the court his marvellous adventures, surpassing those of romance. The beautiful queen, Anne of Austria, touched with compassion at the story of his living martyrdom, kissed his mutilated hands; and the nobles and court ladies vied in acts of tender reverence to the heroic confessor of the faith.

But Jogues was impatient to return to the sacred toils of the Canadian Mission, and in the early spring he set sail from Rochelle for Quebec. There was, however, one impediment to the discharge of his spiritual functions. The Catholic, like the Aaronic priesthood, must be free from personal blemish, and Jogues' mutilated fingers were a barrier to his offering the sacrifice of the mass. But his injuries having been received in

[1] *Ibid.*, 1647, p. 35.

[2] Quel bonheur. . . lorsque *dispersiones Israelis congregabit.* Letter from Jogues to Lalemant, dated from Rennes, Jan. 5, 1644.

the service of the Church, the Pope granted a special dispensation from this canonical disability, and the intrepid missionary hastened to renew his labours, "in the midst of a depraved nation," as the contemporary chronicler expresses it, "without Mass, Sacrifice, Confession, or Sacraments."

To ratify a treaty of peace and to establish a mission among his former tormentors, Father Jogues, with Sieur Bourdon, a French engineer, and six Indians, left Three Rivers on May 16th, 1646. He seems to have had a prescience of his approaching fate. "I go and I shall not return," he wrote to the Superior of the Order, "but I shall be happy if God will accomplish the sacrifice I have begun, and if the little blood I have spent in that land, be as the earnest of that which I will give with all my heart from all the veins of my body." [1]

The projected enterprise was designated, with prophetic significance, "The Mission of Martyrs." Though at first with some natural shrinkings of the flesh which had suffered so much, Jogues at length went with joy to cultivate the vine which he had watered with his own blood,[2] and, as he expresses it, to suck honey from the rock.[3] He again traversed the route marked by his bloody footprints four years before, and on the eve of Corpus Christi reached Lake Horicon, to which he therefore gave the name of Lac du Saint Sacrament. Eight days after, they reached the Iroquois towns, and multitudes thronged to see the object of their former cruelty. A council was held and presents exchanged amid many declarations of friendship. Jogues went the rounds of the wigwams, instructed and confessed some Christian captives, and baptized some dying Iroquois. He soon returned to Canada to report the success of his embassy, having promised to return before winter. On September 24th, he again left Three Rivers to fulfil his pledge. But the short-lived truce was broken. The pent-up rage of the Iroquois burst like a hailstorm on a field of ripened grain and destroyed the hopes of a harvest of souls.

Jogues had left with the Iroquois, for his use on his return, a small box containing clothes and other necessaries. During his absence sickness visited the town, and the corn-fields were smitten with blight. The superstitious fears of the Indians attributed those evils to the malign influence of Jogues and his mysterious box. An angry war-party went forth to take summary vengeance on the hapless missionary. He was intercepted and dragged to the nearest Iroquois town, stripped naked, and made to run the terrible gauntlet amid a perfect hail of blows. From the back and arms of Jogues his persecutors cut strips of quivering flesh, saying, "Let us see whether this is the flesh of a sorcerer." At night he was summoned to the presence of the chief, and as, mangled and bleeding, he entered the lodge, a savage buried his tomahawk in the missionary's brain. His head was immediately hacked off and affixed to the palisade of the town. The Dutch at Fort Orange wrote an account of the murder to Montmagny, the French Governor at Quebec; but it was not till eight months afterwards that the tragic tidings was received.

Thus, on October 18th, 1646, in the thirty-ninth year of his age, the intrepid martyr-missionary completed the sacrifice begun four years before.

In loving eulogy, his Superior, Lalemant, sets forth the lowliness and self-abasement

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[1] *Ibo et non redibo*, etc. Relations, 1647, p. 37.

[2] Cette vigne qu'il auoit arrosée de son sang. *Ibid.*, 1644, p. 73.

[3] *Sugit mel de petra. Ibid.*

of his disposition, his meekness, gentleness and childlike docility, the devoutness of his character and entire consecration of body and soul, will and intellect, to the glory of God and the salvation of souls. So devoid was he of spiritual pride, that it used to afflict him to be asked to show his hands mutilated in the service of Christ. He cherished no resentment toward those who wreaked their cruel tortures on his frame, but regarded them with an eye of pity, as a mother does her child which has been smitten with madness.[1] "I believe," writes Lalemant, "that in heaven he has prayed for the salvation of his murderer, and that his prayer has been granted him." Like the inspired apostle, he "gloried in tribulation also," and used to kiss and embrace the posts of the scaffold on which he so often suffered.[2]

Yet he was naturally of a timid and shrinking disposition, and so great was his self-abasement that he used to say that never had the company of Jesus received a person so vile as himself, nor so unworthy of the habit which he wore.[3] But at the command of duty there was neither monster nor demon which he dared not confront.[4] Though meekly submitting to the greatest indignities of savage malice, bowing his back to the most menial toils, yet when God was mocked, the despised slave rose in native majesty of soul and boldly rebuked his savage masters as Elijah rebuked the priests of Baal.

No one can read the story of the noble lives and martyr deaths of Father Jogues and of many others of the Jesuit Fathers of the wilderness missions without recognizing, notwithstanding all outward differences of creed, the grandest traits of Christian manhood; the saintliness, piety, and purity of their character; their sublime daring, their passionate charity, their enthusiastic love for souls; and to them must be assigned a foremost place in the race of hero spirits who throughout the ages have glorified the annals of mankind.

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[1] Il les regardoit d'vn œil de compassion comme vne mere regarde vn sien enfant frappé d'vne maladie phrenetique. *Ibid.*, 1647, p. 40.

[2] Les poteaux qui soustenoient l'echafaut où il auoit tant souffert, il les alloit baisser et embrasser. *Ibid.*, p. 39.

[3] Iamais la compagnie n'auoit receu une personne si lasche que luy, ny si indigne de l'habit qu'il portoit. *Ibid.*

[4] Il n'y a monstre, il n'y a Démon qu'il n'eust affronté auec cette parole. *Ibid.*, p. 40.

V.—*The Annals of an Old Society.*

By JOHN M. HARPER, B.A., Ph.D., F.E.I.S.

(Read May 28, 1885.)

No name stands out more prominently in the pages of Canadian history than that of the city of Quebec. With its records of sieges, battles, and political movements, the old town forms an excellent vantage-ground for the student of history. Here he may watch, as through a kaleidoscope, the grouping of events round the nucleus of a new nation. As he saunters through its narrow streets, where the dim religious light of the past still seems to play, or as he breathes the higher air of its citadel and ramparts to find in it still the flavour of war, his interest is awakened and warms into enthusiasm. He has read of the past of Canada, but here he seems to live in it. Here he finds:

> "The glimpses of an outer beauty shine,
> Like hope around the corner of a task,
> To guide his footsteps lingering near the scenes
> Of triumph and defeat. In *cul-de-sac*
> And thoroughfare the very stones reflect
> Some mosaic of events; within them flows
> The tide of peaceful life, and yet the ebb
> Of other days still ripples in its calm,
> To sing of clanging arms and military parade,
> To chant the martial song of valiant men
> Impatient to possess, or moan the dirge
> Of dire retreat that knocks at every gate."

And as he passes from battle-field to bastion, from embrasure and glacis to esplanade and terrace, from restored convents and churches, with their relics and tombs, to decayed mansions and palaces hallowed by the labours of the antiquary and novelist, he can watch, with increasing pleasure, the light and shade of minor events and social life playing around the events of a higher historic dignity.

And what Quebec is to Canada from an historical point of view, the Chateau St. Louis, or all that remains of it in Castle Haldimand, is to the city itself. If the quaint grouping of buildings within the walls seems but a bit of the Old World set down on the borders of the New, the relics of the old Chateau no less shed a borrowed light from the social traditions of France and England. The historic nook, once its site, lies at the head of the steep thoroughfare that connects the lower with the upper town, and is as celebrated as the prospect-point of

> "That beauteous shrine of nature gay festooned
> With woodland grandeur, where the fervent soul
> May drink a draught from summer's rippling bloom,"

as it is for the memories which linger around it, and which have formed the foundation of many a romantic tale and memoir. As the enthusiastic lover of nature stands here in the shadows of night,

> "Within a flood of festive light that glares
> A dazzling nucleus, 'mid encircling gloom,
> Where earth below seems heaven for brilliant stars,
> That twinkle in the landscape and the glass
> Of waters gleaming like a nether sky,—"

his thoughts naturally turn to the scenes of early times, when those gossip-groups of knights and courtly dames, which William Kirby has immortalized, stood within the Chateau's enclosure to admire the encirclement of nature's charms. The tints of tradition in "Chien d'Or," however much they borrow their brilliancy from the imagination of its author, are not inconsistent with the mental influences born of the locality he has described and its picturesque surroundings. The spot is a pleasure ground for antiquary and poet. Here the imagination may revel in its sweetest delights and draw sunshine from the memorials of primitive colonial life. Within the precincts of this little plateau the old *bourgeoisie* and *noblesse* of Quebec were accustomed to throng on *fête* days, to pay court to the representatives of Bourbon pomp and power; and here it was, as fate's fitting tribute to the strength of Champlain's fort, and the luxury of Frontenac's abode, that an English Governor-General laid the foundation lines of the oldest historical society in the country.

In 1820, the Earl of Dalhousie became Governor-General of Canada. He was no untried man in affairs of state, and could boast of a military career of great distinction, having served in the Peninsular War under Wellington, and in the later campaign against Napoleon which ended on the field of Waterloo. As Governor of Nova Scotia, in the face of political prejudice and party strife, he had succeeded in leaving behind him the impression that he had wished well to that province, and to the present day, his efforts to improve the intellectual status of the Nova Scotians, by suggesting plans of collegiate consolidation, are happily commemorated in the success of the university he founded and which still bears his name. Though more of the soldier than the scholar, he took a keen interest in all that pertained to progress in the arts and sciences, even when the pursuit of these was held in anything but favour by the communities over which he was called upon to rule. Nor is it to be wondered at, that he should seek, shortly after his arrival at Quebec, to throw his influence in the direction of literary progress. The history of the French *régime* had yet to be written. Canada had a past; but the memorials of that past were scattered everywhere, and had to be collected; and, no doubt feeling assured that these records, when collected, would be of service by promoting in the minds of the colonists a deeper respect for Canadian institutions, Lord Dalhousie was easily induced to inaugurate a movement having for its main intention the collection and preservation of records referring to the annals of the country.

To discuss the practical steps that had to be taken in furthering such an object, a preliminary meeting was held in the Chateau St. Louis towards the close of the year 1823. The meeting was attended by the principal citizens of Quebec, having been called together at the instance of the Governor-General, who was anxious, no doubt, to see his plans in

favour of historical research in a fair way of being carried out, before he left for England on a visit in 1824.

It is needless to say that his Lordship's suggestions were favourably considered. In the preface inserted in the first issue of the Transactions of the Society, the difficulties in the way of promoting the project are referred to,—especially those difficulties peculiar to a country such as Canada, where, with few exceptions, the occupations of men are such as to leave but little leisure for scientific enquiry. Yet one has only to run his eye down the list of those who took an active part in maturing Lord Dalhousie's plans, to note how many of them were truly capable men—men in whom the literary spirit was so far developed as to secure from them due appreciation of the project in all its importance. In enumerating but a few of them, we may mention the Hon. Jonathan Sewell, Chief-Justice of the province, a man of keen judgment and strong sympathies, whose influence in the community was paramount in religious and secular matters: he it was who founded Trinity Church, and yet was broad enough in his views to foster the dramatic art by founding also the first theatre in Quebec,—altogether a gentleman of culture, as ready at times to court the Muses as to dissect some juridical theory, and always willing to lend a helping hand in whatever tended towards the intellectual improvement of his fellow-citizens. There was also Dr. John Charlton Fisher, who had been consulted, not unfrequently, by the Governor-General upon political affairs, and whose advice, in literary matters, was enhanced by the training which he had received as one of the editors of the New York *Albion*, and which he subsequently showed to such advantage as joint-compiler of that interesting volume, Hawkins' "Picture of Quebec." There was Captain Henry (afterwards Admiral) Bayfield, the first to investigate the geology of many remote districts in Canada, and the first to define the topography of lands adjacent to its coast-waters, and to report upon their climate and mineral resources. There was Dr. Daniel Wilkie, whose learning was more than that of the average schoolmaster, a simple-hearted Scotchman with a fondness for metaphysical investigations; and there was Bishop Mountain, who had found time amid his many pressing pastoral cares to compose a volume of lyrics under the title of "Songs of the Wilderness." Nor need we overlook such names as Andrew Stuart, the eminent jurist; Joseph François Perrault, the pioneer of elementary education in the province, about whom his grandson, Dr. P. Bender, has lately published a pleasant volume; William Sheppard, the enthusiastic naturalist of Woodfield; William Green, a shrewd observer of men and things, and first secretary of the Society; Lieutenant Baddeley, who wrote some excellent papers on the Saguenay country; and G. C. Wicksteed, who is as fond of spinning verses in his eightieth year as he was in his eighteenth. By men such as these, Lord Dalhousie's proposals were discussed with the greatest enthusiasm, and so speedily were all further preliminary arrangements matured, that the new year was only a week old when his Lordship was called upon to preside at the first regular meeting of the Literary and Historical Society of Quebec.

The *éclat* attending the organization of the young Society served to heighten its ambition, and if this ambition, as it stands recorded in the first pamphlet issued by the Council in 1824, has not been completely realised, yet we cannot but admire the enthusiastic ring about the public address, which, among other things, this pamphlet of twenty pages contains. While pointing out how far the field of historical research is an interesting one, this address urges upon the attention of all the rich materials of folk-lore and tradition

which lay neglected, and which, when collected and arranged, would tend to lead to the better appreciation of Canadian history. The foremost object of the Society, as the pamphlet proceeds to say, was to discover and preserve the earliest traces of events in the country, to arrange all documents pertaining to these events, and to encourage and recompense all who assisted in the undertaking.

In this praiseworthy proposal to recover, translate, and publish the original records of Canadian history, it may be interesting to our *littérateurs* to take note that the Society did not propose to make literary research a mere labour of love. Men were to receive some recompense for their labours, a doctrine, which, notwithstanding the good example of the Quebec Literary and Historical Society, has not made much practical progress in our midst. Literary men have yet to take the will for the deed when they look to Canadian publishers for support. Our last literary venture of payment by results, the *Canadian Monthly*, has but lately failed financially, perhaps to be followed by similar failures for many years to come. And in face of such a fact, there is surely some credit due to the Society that continued, in the face of many difficulties, to reward its most zealous workers as far as its funds permitted. These funds, chiefly derived from members' subscriptions, were originally augmented by a grant of four hundred dollars from the public treasury during the period of Lord Dalhousie's rule in Canada, and this amount, with further sums drawn from time to time from the Government, enabled the Council to offer prizes for essays and to hold gatherings with a view to literary and scientific progress.

A copy of the first volume of the Transactions, which did not appear in print till the year 1829, is lying before me as I write; but, before I dip into its quaint productions to see what the Society was about in the early days of its inception, it may be worth our while to try to catch a glimpse of Canadian literature previous to the time of this volume's appearance.

In 1824, the city of Quebec had less than half of its present population, while that of the whole of Canada was little over half a million; and while it is known that, beyond the somewhat stormy arena of politics, very few books of any moment had been published, it is not difficult to find the cause of such a state of affairs. At that time men had to work hard for a living, just as hard as many men now labour to acquire more wealth than they require. They knew little of a higher culture and mental refinement. Struggling with difficulties which we can hardly realize, they had neither time nor inclination to foster the literary spirit in themselves or in others. Beyond attending church on Sundays, or taking part in the ordinary parish meetings, their highest intellectual excitement was to listen at election times to the vote-begging logic of some politician on the canvass, or to read the local newspaper, whose editor, in all likelihood, was accustomed to view every current event through the prism of faction. And yet, in spite of all this, the literary spirit showed signs of germination, just as to-day it shows signs of no ignoble development. When the founders of the Quebec Society declared in their prospectus that such an association as theirs would raise Canada in the moral and intellectual scale of nations, they must have had some evidence before them that a national spirit was beginning to show signs of growth in the community. "It will cherish our noblest feelings of honour and patriotism by showing that, the more men become acquainted with the history of their country, the more they prize both their country and themselves," is a form of speech that must have had more than theory behind its utterance. In a word, the

birth of a new literary *régime* was in the air. Poets were beginning to sing of Canadian scenes, and lecturers were venturing on Canadian subjects. In the preceding year, a magazine had been started in Montreal, whose pages bear witness to this fact, and it was followed by a rival in 1824. In the same year a novel was issued from the Kingston press, illustrative of Canadian manners and customs, and the columns of the newspapers were beginning to touch on kindred topics in prose and verse. Previously, the intellectual activity of the country had sought its fame in political aggrandisement, but now even the politicians began to see that the writing of history was as honourable as the making of history, and sought to favour the historian in his efforts to place upon record all that was known or could be learned of his country. Nor in view of subsequent events, can we think slightingly of the exalted tone of the citizens of Quebec, when they say that it is fair to expect, from the formation of such a literary association as theirs, "the creation of a lasting bond of union and correspondence between men eminent for rank, erudition, and genius, from one extremity of the British provinces to the other." At first thought, there may appear in such a statement a little inflation of language, yet it is a well-known fact that during the first decade of their Society's existence, there was to be witnessed throughout the whole country a literary activity which not only gave birth to many societies of a kindred character, but which nurtured the rising fame of the poets, historians, and essayists, whose names are to-day proudly recorded on the pages of the history of Canadian literature. If the Quebec Society has not as yet realized its early ambition to the full, it can at least claim to have been one of the earliest exponents of the literary spirit in the country. If its sympathies to a large extent have been local, its labours have been none the less cosmopolitan; while it has enjoyed the co-operation directly or indirectly of nearly all those societies which have taken an interest in the preservation of Canadian historical records. The documents in its possession and the memoirs it has published from time to time have been of the greatest service to the writers who have discussed Canadian themes; and in this, if in no other way, it has had something to do with the building-up of whatever of a national spirit there is in Canada. As a local institution, it has done much to foster the literary spirit among the citizens of Quebec, by providing them with an excellent library and museum, as well as by arranging conferences during the winter months for the discussion of literary and scientific subjects; yet its higher fame may fairly seek to blend itself with the events attending the birth of Canadian literature, at a time when men began to look upon Canada as being something more than a mere makeshift in their lives, when the spirit of a higher intelligence began to make itself felt amid political bickerings and a mere striving after a physical existence.

It was not until the month of November, 1829, that the first copy of the Transactions of the Society was issued in the form of a goodly volume of two hundred and sixty pages, bearing the imprint of François Le Maitre of the *Star* office. At first, the meetings of the association continued to be held in the Chateau St. Louis, and the above volume, in mentioning this fact, contains a certificate from William Green, the Secretary, to the effect that "an assembly took place on Monday, the 31st of May, 1824, when an inaugural address and essay on the early civil, ecclesiastical, and juridical history of France was read by the Hon. Jonathan Sewell, Chief-Justice of Lower Canada." It is unfortunate that the full record of the meetings of the Society in its earlier days is lost to us,—the minutes having in all probability been burned in the fires which, on two different occasions, were attended

with serious loss both to the library and museum. A picture of the old Chateau is still extant, exhibiting the main building rising on its eyry near the rocks over which Durham Terrace was subsequently built. As the light streams from its windows on this memorable night and floods court-yard and outlook, one is fain to peer through the glass at the old citizens of Quebec in assembly, whom our antiquary, Mr. J. M. LeMoine, has laboured so diligently to identify. But the list of membership is all that we have to guide us, and the lines of identification are too indistinct to be of much service. Yet it is not difficult to recognize the man who sits to the right of Lord Dalhousie. Small in stature, yet dignified in his bearing, his face has in it the lineaments of one who has succeeded in the world by the force of intellect. Of an old Loyalist stock, he had found his way to New Brunswick in 1785, where, living among those of his own kindred and political principles, he studied law in the office of Ward Chipman, one of the founders of the city of St. John. After completing his course of study as the first law student in New Brunswick, he selected Quebec as a place of residence; and there, passing from one stage of promotion to another in the law courts of his adopted province, he finally attained to the exalted position of Chief-Justice and President of the Executive Council. At the time of which we write, he was a man of about sixty years of age, with sixteen years of his life still to run, as anxious as ever to promote the interests of the city which had witnessed his marvellous success as a lawyer. He was the first President elect of the Literary and Historical Society of Quebec,—a fitting recognition of the active part he took in its organization.

To understand fully the origin of the Society we have for a moment to go behind the scenes. Lord Dalhousie was the founder of the Society, but it was Dr. John Charlton Fisher that was really its originator. That gentleman had been invited from New York to undertake the editorship of the *Official Gazette*, published at Quebec in the interest of Lord Dalhousie's administration. As affairs were conducted before the days of responsible government, the personality of the Governor-General was more intimately mixed up with political issues than it is now-a-days; and it is said that, becoming dissatisfied with the political tone of the *Official Gazette*, which was conducted by John Neilson, Lord Dalhousie had encouraged Dr. Fisher to try his fortune in the ancient capital, promising to procure for him as an initial support the printing and advertising in the gift of the Government. In New York he had made for himself a literary reputation, and having taken an active part in the work of the Literary and Historical Society of that city, he naturally sought to organize a similar society in Canada when he took up his abode in Quebec. Coming in contact with the Chief-Justice in connection with the affairs of the administration, he doubtless laid his plans before him and His Excellency, and through their co-operation finally secured the permanence of the new Society.

Chief-Justice Sewell, in his inaugural address, refers to the meritorious purpose of the Society and the results to be expected from its proposed work. "Appointed to address a Society," he is reported as saying, "distinguished in its origin by the rank and character of its noble founder, and in the first stage of its progress by the respectability and talents of its numerous members, whose high and meritorious purpose is to extend more amply the advantages of science and literature to a remote but rising portion of the great empire to which we belong and the beneficial effects of its disinterested labours to future times, I am anxious to devote the time, during which I hope to be honoured with your attention, to a subject which, corresponding with the views of our institution and involving matter

interesting to science, may, in some degree, be worthy of your notice." Proceeding to place the subject of his paper before his audience in the light of the historical era previous to the erection of the Sovereign Council of Quebec in 1663, he speaks of the period when the laws of France, as they had been administered in the tribunals of the Comte de Paris, became the common law of Lower Canada. His paper, the first ever published by the Society, is full of research, as the copious notes and references readily show. The interest of Canadians is specially excited by a perusal of the latter part of the thirty-six closely printed pages, in which the connection between church and state and the function of ecclesiastical law are carefully explained. In every page, there is a clear indication of the extent of the author's juridical information. The arrangement is excellent, and the style dignified and fluent. Nor did the lecturer forget the occasion of his address while pointing out its utility. His closing sentences foreshadow the progress that has been made in the study of the law of Canada within the last fifty years, while affording to us, who read them now, an instructive glimpse of the course of a young lawyer previous to 1824.

The second paper published in the Transactions is one on the geology of Lake Superior by Henry Bayfield, Commander in the Royal Navy. Commander Bayfield was a resident of Quebec from 1827 to 1841, when he removed to Charlottetown. The story of his life is full of incident. After an experience of several important naval engagements, he was finally placed in command of a gunboat for service on the Canadian lakes at the close of the American War of 1812–14, where for ten years he was engaged in making a survey of the largest of them. And the paper, which follows Chief-Justice Sewell's, shows how carefully he performed his duties. He was not the first to visit the great lake with a view to geological investigation, and to those who preceded him, he gives credit for their enterprise. He claimed, however, to be the only person who had circumnavigated the lake or visited all its bays and islands, in order to trace the formations from shore to shore. Two years ago, Admiral Bayfield passed away at the ripe age of ninety, having lived almost beyond the recollection of the world in which he was at one time a man of mark, and little noticed at the time of his death except by those living in his immediate vicinity. During his residence in Quebec, he put forth every effort to foster the interests of the Literary and Historical Society, finding the time, notwithstanding his onerous duties, to write several papers to be read before its members.

Next in order of publication to Admiral Bayfield's paper, is one by Andrew Stuart on Saguenay County,—a paper greatly enhanced in value, when read in conjunction with one which follows it, on the geognosy of the same district, by Lieutenant Baddeley of the Royal Engineers. The paper on the Saguenay was not the only contribution Mr. Stuart read before the Society. He wrote subsequently an account of the "Ancient Etruscans" and an essay entitled "Detached Thoughts upon the History of Civilization," both of which indicate the extent of their author's reading, the keenness of his judgment, and his powers of observation.

Among the contents of the first issue of the Transactions are two papers by Captain Bonnycastle, one entitled "Observations on a few of the Rocks and Minerals of Upper Canada," and the other on "Meteorological Phenomena observed in Canada." William Sheppard makes some "Observations on the American plants described by Charlevoix;" Mrs. Sheppard writes of "The recent Shells which characterize Quebec and its Environs,"

and the Countess of Dalhousie has her name associated with a catalogue of Canadian plants, which is inserted at the end of the volume.

Under such auspices the Literary and Historical Society became an important element in the history of Canadian literature. As may be noticed from the nature of the papers which comprise the first two volumes of the Transactions, there was not much attention given to investigations pertaining to Canadian history. The world was beginning to be excited over the discoveries in the field of natural science, and much of the energy of the Society was devoted to scientific discussions and the organization of a museum, stored with all that was curious in connection with animal and vegetable life. The encouragement of Canadian literature was, however, by no means overlooked altogether, for, even as early as 1828, a French poem entitled "Le Siége de Missolonghi" was brought to light under the auspices of the Society as well as an English one under the name of the "Canadian Harp."

In examining the title-page of the first issue of the Transactions we find the date of 1829 on its imprint, whereas the Society was in reality organized in 1824. The seeming anachronism is explained by the fact that in 1827 a Society, in which the French Canadian influence predominated, was organized for the encouragement of the arts and sciences. When Sir James Kempt came to Canada, he was appointed patron of both these Societies, and thinking, no doubt, that their fusion as one Society might lead to excellent results in more ways than one, he proposed that they should be united under the name of a "Society for Promoting Literature, Science, Arts and Historical Research in Canada." The union took place according to the wishes of the Viceroy, but the original name recognised by the Society founded by Lord Dalhousie was adhered to, when the Transactions came to be printed in the year 1829. At the time of this fusion, the Society numbered one hundred and thirty members, and since that time it has never lost its cosmopolitan character, French-speaking citizens uniting heartily with their English-speaking townsmen in advancing its interests, and occupying places of prominence on its official list. At this time, there was indeed the most praiseworthy zeal exhibited in all the departments of the Society's work, in connection with the cultivation of literary and scientific tastes and pursuits. Though the library in the matter of historical volumes, was to some extent neglected, the museum began to assume respectable proportions, a lecturer was appointed to interest the members in the studies of geology and mineralogy, while several committees were organized to conduct investigations in natural history and literature. In 1831, no less than thirty-two prizes were distributed for essays on various subjects, and a large sum of money, supplemented by a grant of two hundred and fifty pounds from the Government was laid out in books on scientific subjects, and apparatus for chemical analysis and experiments in natural science and astronomy.

When, however, the Society had been honoured by the grant of a royal charter, the members began to consider how they could sustain the dignity of its position by the character of its work. As Louis Turcotte remarks, up to this time the members had been engaged in encouraging the study of the physical sciences, reserving for better times, perhaps, the realization of the principal object that the founders of the Society had in view, namely, historical research, and the publication of the annals of the country. But in the year after the royal charter had been bestowed upon the Society, affairs began to turn in the right direction, as far as the collecting of documents referring to French discovery and

French rule in Canada was concerned. From the minutes of the Council we learn that, in 1832, a grant had been sanctioned by the House of Assembly, for the purchase of documents in England and France, or to defray the expenses connected with the transcribing of such, and as the story of such enterprise cannot but be interesting to all who recognise with increasing satisfaction the achievements of the Archives Department as it is at present organized under the excellent system introduced by Mr. Douglas Brymner, it may be worth our while to follow it in its continuity, apart from the various other incidents of the Society's growth.

At first, a sum of forty pounds, taken from the original vote of two hundred pounds made by the Government, was placed in the hands of a London agent to meet contingencies in paving the way for access to the documents in the possession of the authorities of France and England. This was in 1833; but it was not until four years afterwards, that the first collection was made through the kind offices of Lord Aylmer, who, in succeeding Sir James Kempt as Governor-General, became the patron of the Society and did everything in his power to advance its interests. A Special Committee on Historical Documents had been appointed, through which correspondence, with those who were in a position to favour the enquiries of the association, was to be conducted; but for years the efforts of this committee were attended with anything but success. At length, as an earnest of the committee's determination to succeed, a memoir relating to Canadian affairs from 1749 to 1760, was obtained from Colonel Christie, and put in the hands of the printer. Subsequently a number of rare books and manuscripts were forwarded by Abbé Holmes from Paris, which assisted in elucidating the same period, and extended in their scope from 1750 to 1779. In these events we may find the indirect origin of the magnificent collection which now lies in the vaults of the Parliament Buildings at Ottawa,—the modest beginning of an enterprise so important to our country.

Encouraged by these successes, the committee, it is needless to say, persevered in their work, and in 1830 were in a position to report that through the agency of the Hon. Mr. Cochrane, once a president of the Society, they had procured additional books of travels and notes on voyages to America, many of them having special reference to the sufferings of the first colonists, and containing memorabilia of subsequent periods. At first, the Society, in its labours in this direction, had to depend, to a large extent, upon the influence which the several Governors-General could bring to bear upon those who had charge of the archives of France and England. Lord Durham was one of those who took an active part in assisting the Society, not only presenting a valuable collection of books illustrating the history of Canada, but, during a short visit to Paris, giving instructions to have several manuscripts copied and sent to Quebec from Versailles. Those members who had opportunities of visiting Europe, at a time when a holiday spent on the continent was an event of rarer occurrence among us than it is now, did not lose sight of the interests of the Society during their travels,—some of them, as in the case of Mr. Cochrane and Abbé Holmes, assisting to establish those friendly relations between Quebec and the literary societies of Europe, which have been maintained to the present day. Mr. Cochrane, a lawyer of distinction, and a member of the Executive Council holding several important positions in the country, was one of those who encouraged the Society to prosecute its labours. He was one of those who took a deep interest in all matters pertaining to the advancement of literature and science in Canada, a man of remarkable memory and

studious habits, and possessing a reputation for integrity and official ability. It was during his visit to England on public affairs in 1839, that he took time from his pressing official duties to make some valuable collections for the Literary and Historical Society of Quebec.

To Abbé Holmes is also due much credit for the industry which he showed in the Society's affairs, both at home and abroad. As a distinguished teacher in the Laval Seminary, he took great delight in the study of botany and geography, and his career in that institution shows how well he understood the true principles of education, as well as the natural methods of imparting instruction. In 1836, he was sent on a mission to Europe by the Government, to examine the systems of normal training then in use in the various countries. During his visit he made several collections of books and documents, and completed arrangements with societies in Great Britain, France, Belgium, and Italy, for an exchange of publications with the Quebec Society, of which he was a prominent member, being at one time engaged on the Committee on Historical Documents, and president of the arts class.

In 1840, a selection was made from the documents procured in this way and printed for distribution as exchanges. Three years later, the journals of Jacques Cartier, which had long been out of print, were republished under the auspices of the Society. Of this reprint, it is said, that it was taken from a manuscript in the Royal Library of Paris, supposed to be a transcript of the original writing of the navigator himself. Subsequently the committee also published a pamphlet including the voyages of Cartier and Roberval.

Owing to lack of funds, and the disinclination of Parliament to make a sufficient grant to meet the expenses of pursuing investigations in Europe, the Society made arrangements, in 1846, to procure copies of some of the transcripts in the Broadhead collection at Albany. Mr. Cochrane went in person to Albany to mark the portions to be selected from the thirty-eight volumes in the collection, and after six months' labour the copyist had placed in the keeping of the Society over twelve hundred pages of manuscript. In this way the association began fully to realize, through its operations, the main purpose of its organization. Its permanent usefulness was now assured, and before long the success which had attended the activity of the Committee on Historical Documents, excited in others a desire to take part in the undertaking of collecting, from every country, whatever historical information they could find bearing upon Canada. Mention has only to be made of the valuable collection of manuscripts made in France by Mr. Faribault, and finally placed in Laval University; the collection prepared in London, and arranged in six volumes for the Society; and that known as the Papineau collection deposited partly with the Society and partly in the library of the Provincial Parliament,—to show how far the work began to assume a phase of the greatest importance to the writers of history. I might go on to show how the Society, guided towards the spirit of enthusiasm by Dr. Anderson, J. M. LeMoine, and Dr. Miles, used its influence in behalf of an Archives Department, to be organized by the Federal Government. In concluding this brief paper on the early annals of our Society, I can only use the words of Louis Turcotte, whose early death was such a loss to Canadian literature. "Such," says he, "are the services which our predecessors rendered at that time to the history of Canada, by the publication of so many valuable memoirs, and by the collection of so many manuscripts. Previously they had been otherwise engaged. Yet now, in face of statements which pointed to some

documents as having been lost by negligence, and others by fire, patriotism advanced a step by placing at the disposal of our historians so many original documents, which fill up the gaps in our history, by seeking to spread a taste for research, by bringing to light the beauties of the past to adorn the writings of the present." And it surely was progress worthy of the admiration of Canadian and foreigner alike.

VI.—*The Artistic Faculty in Aboriginal Races.*

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Among various characteristics of native American races which invite attention, the prevalence of an aptitude for imitative art is one that merits careful study; and to this fresh interest attaches owing to recent disclosures. It is not, indeed, to be overlooked that if due allowance is made for the narrower range in degrees of civilization among the races of the New World, as compared with those of Europe or Asia, the same diversity of racial characteristics is observable here as elsewhere. The tendency, moreover, of civilization is to efface, or greatly to modify such distinctions. Diversities in capacity and character are in reality much greater among barbarous tribes than among civilized nations, who habitually borrow the arts, and imitate the social habits of neighbouring races, or accept some common standard of intellectual and moral preeminence. Nevertheless, while the capacity for imitative art is neither peculiar to this continent, nor characteristic of all its diverse nationalities, it appears to be more generally diffused among the races of America than elsewhere. It is prevalent among tribes in nearly every condition, from the rude Indian nomad, or the Eskimo, to the semi-civilized Zuni, or the skilled matallurgists and architects of Central America and Peru.

This development of a feeling for art in savage races is at all times interesting as indicative of intellectual capacity and powers of observation, even when manifested, as it frequently is, within a very narrow range. It is by no means a general characteristic either of savage or civilized man. Yet recent archæological discoveries prove it to have been one of the earliest forms of intellectual activity among the cave-dwellers of Europe's palæolithic dawn. The most civilized nations have differed widely in the manifestations of this æsthetic faculty. The city of Dante was the Athens of the Middle Ages in art as well as letters; while the land which gave birth to Shakespeare can scarcely be said to have had a native school of painting or sculpture till late in the eighteenth century. The like differences are observable among barbarous nations. Races are met with, to whom the drawing of a familiar object suggests no idea of the original; while others, in nearly the same stage of savage life, habitually practice the representation of natural objects in the decorative details of their implements and articles of dress, and in the carvings which furnish occupation for many leisure hours.

A special interest attaches to the disclosures of archæology relative to the prehistoric races of Europe, owing to the evidence thereby furnished of many striking resemblances in their arts and conditions of life to those of uncultured races of our own day, and especially to the aborigines of this continent. In many respects it seems as though the present con-

dition of the latter only repeats that of Europe's infancy. But when the contents of the barrows, cairns, and grave-mounds of prehistoric Europe are brought into comparison with those of the New World, the analogy fails in so far as imitative art is concerned. If, indeed, we leave behind us the age of cromlechs, kistvaens, cairns and barrows; and seek to estimate aright the startling disclosures of artistic ability pertaining to the far more ancient men of Europe's Mammoth and Reindeer Periods, it is otherwise. But, before considering the wonderfully definite glimpses thereby furnished of tribes of rude yet skilful hunters of that post-glacial world, it may be of some help, in the comparisons which they suggest, to recall impressions derived from a study of that Stone Period, when the natives of the British Islands appear to have approximated, in many respects, to the Red Indian nomad of the American forest.

One little-heeded point of evidence of this correspondence, to which I long since drew attention, is to be found in the traces of artificial modification of the head-form in ancient British crania; a comparison of which with skulls, recovered from Indian grave-mounds of this continent, helps to throw light on the habits and social life of the British Islands in prehistoric times. In illustration of this I may refer to an exploration, now of old date. In the early summer of 1851, I learned of the accidental discovery of a stone cist, in trenching a garden at Juniper Green, a few miles distant from Edinburgh, and immediately proceeded to the spot. There, under a slightly elevated knoll—the remains, in all probability, of the ancient barrow,—lay a rude sarcophagus of unhewn sandstone, within which was a male skeleton, still in good preservation. The body had been laid on its left side, with the arms folded over the breast, and the knees drawn up so as to touch the elbows. A flat waterworn stone had formed the pillow, from which the skull had rolled to the bottom of the cist. Above the right shoulder stood a gracefully formed clay vase, containing only a little sand and black dust, the remains, it may be presumed, of food which it originally contained when deposited there by affectionate hands, in some old, forgotten century. It was recovered uninjured, and is now deposited, along with the skull, in the Archæological Museum of Edinburgh.

The primitive grave, thus discovered within sight of the Scottish capital, has a curious interest in many ways, as a link connecting the present with a remote past. But the special point which throws light on the habits of the ancient race, is a parieto-occipital flattening, such as is of common occurence in skulls recovered from the ossuaries and grave-mounds of this continent. This feature is clearly traceable to the use of the cradle-board in infancy. The mode of nursing the Indian papoose, by bandaging it on a cradle-board, is specially adapted to the vicissitudes of a nomad forest life. The infant is carried safely, slung on the mother's back, leaving her hands free; and in the pauses of her journey, or when engaged in field-work, it can be laid aside, or suspended from the branch of a tree, without risk of injury. But one result of this custom is that the soft bones of the skull are subjected to a continuous pressure in one direction during the whole term of suckling, which is necessarily protracted, among a nomad people, much longer than is usual in settled communities; and to this cause is undoubtedly traceable the occipital flattening of many skulls recovered from European cists and barrows. Dr. L. A. Gosse, after discussing in his "Essai sur les déformations artificielles du Crâne" certain artificial modifications of the skull, of common occurrence among the aborigines of this continent, thus proceeds: "Passant dans l'ancient continent, ne tourdons-nous pas à reconnaître que ce berceau plat

et solide y a produit des effets analogues. Les anciens habitants de la Scandinavie et de la Calédonie devaient s'en servir, si l'on en juge par la forme de leurs crânes."[1]

Full-sized representations of the Juniper Green skull, and others of the same type, are given in "Crania Britannica,"[2] among which may be specially noted a small skull recovered from a cist in the Phœnix Park, Dublin, and now preserved in the Museum of Trinity College. Mr. Thomas Bateman also, in his "Ten Year's Diggings in Celtic and Saxon Grave-hills," concurs with earlier writers in ascribing to the use of the cradle-board the flattened occiput observed in skulls recovered from ancient British barrows. The employment, indeed, of the cradle-board among prehistoric races of Northern Europe, and their nomad life of which it is so characteristic a feature, may now be considered as generally recognized. The implements and pottery recovered from graves of the period show their constructors to have been, for the most part, devoid of any knowledge of metals; or, at best, in the mere rudimentary stage of metallurgic arts. But the Juniper Green cist, that of the large Staffordshire barrow of Wotton Hill, that of Roundway Hill, North Wilts, another of Green Lowe, Derbyshire, and others described in the works above referred to, while all disclosing evidence of correspondence in habits and social condition between ancient races of the British Isles and the Indians of the New World, also furnished characteristic examples of their fictile ware; and here the analogy fails. There are, indeed, abundant specimens of broken Indian pottery, such as occur on many long-deserted village sites, which might be mingled with the fragments of a like kind from early European grave-mounds without attracting special attention. Simple chevron and saltier or herring-bone patterns, scratched with a pointed bone on the soft clay, are common to both; and many of the more elaborate linear and bead patterns of the primitive British potters reappear with slight variation on the Indian ware. But besides these, few ancient Indian village sites fail to yield fragments of pottery, including clay tobacco pipes, ornamented with more or less rude imitations of the human face and of animals of most frequent occurrence, such as the beaver, the bear, the lynx and the deer. Before my first visit to the American continent, while still preoccupied with the arts of the ancient British savage, and the more graceful devices of the metallurgists of Europe's Bronze Period, I noted the prevalence of an ornamentation, consisting mainly of improvements on what may be called the accidents of manufacture, or possibly of linear decorations borrowed from patterns of the plaiter or knitter.[3] No attempt appears to have been made by the old European decorator at such imitations of familiar natural objects, as are now known to have been practised among the far more ancient cave-dwellers of Europe, the contemporaries of the mammoth and the woolly rhinoceros, and which are familiar to us in the primitive arts of the New World. Objects recovered from the mounds of the Ohio and the Mississippi valleys, as well as the diversified products of the native artificers of Mexico and Peru, attract special attention by their endless variety of imitative design; and similar skill and ingenuity are apparent in the pottery, the plaited manufactures, the stone and bone carvings, and even in many of the great animal mounds and other earthworks, of the North American continent. An observant recognition of analogies, traceable in the rhetorical construction of

[1] Essai sur les déformations artificielles du Crâne, p. 74.
[2] Crania Britannica, vi. Pl. 15; xiv. Pl. 12; xxxii. Pl. 42.
[3] See Prehistoric Annals of Scotland, 2nd Ed., i. 495.

many American Indian holophrasms, appears to be one natural result of this widely prevalent imitative faculty. At the same time, it has ever to be kept in view that, whether we study the physical form or the intellectual characteristics of native American races, it becomes more and more apparent that the New World has been peopled from different centres, and still presents essentially distinct types of race. It had its ferocious Caribs, its Mexicans with their revolting human sacrifices and other bloody rites, and its stealthy treacherous nomads, less courageous but not less cruel. But it has also gentler races, in whom, as in the Peruvians, the Zunis, and others of the Pueblo Indians, the æsthetic faculty predominates, and overlays with many a graceful concomitant the utilitarian products of their industrial arts.

Whether barbarous or civilized nations are grouped and classified in accordance with their linguistic affinities, both are found to manifest other specialties which accord with the diverse families of speech. The essential differences which separate the Aryan from the Semitic races are not more marked than the intellectual and moral divergencies among barbarous tribes. But while this is apparent on the American continent, its diverse races are undoubtedly characterized by a more general aptitude for artistic imitation than is observable elsewhere, except among the long-civilized nations of the Old World, whose composite languages reveal the sources of many borrowed arts. The Peruvian potter sketched and modelled endless quaint devices in clay; the Zunian decorated his gracefully fashioned ware with highly effective parti-coloured designs; and the old Mound-builder wrought in intaglio on his domestic and sepulchral vessels conventional flower patterns, and in his miniature sculptures reproduced the fauna of an area extending from the Ohio to the Gulf of Mexico. Native artificers of widely different American races manifest this imitative faculty. Not only is the Indian pipe-sculptor found copying animate and inanimate objects with an observant eye and a ready hand; but even the linear patterns on pottery and straw basket-work are frequently made to assume combinations obviously suggested by flowers and other familiar objects of nature. The perception of such analogies, and even the capacity for appreciating the linear or pictorial representation of objects on a flat surface, varies greatly in different races. Travellers have repeatedly described the manifestation by savage races of an utter incapacity to comprehend pictured representations. Mr. Oldfield, for example, tells how a large coloured engraving of a native of New Holland was shewn to some Australians. "One declared it to be a ship, another a kangaroo, and so on, not one of a dozen identifying the portrait as having any connection with himself."[1] The artistic faculty is unquestionably hereditary. There are artistic families and artistic races. But if so, the pictorial skill of the palæolithic cave-dwellers of Western Europe was not transmitted to their successors. Guided not only by a comparison of their tools and weapons with those of the Neolithic Period, but also by cranial and other physical evidence, we are led to assume the absence of any affinity between the men of the Perigord caves and the rude but greatly more modern races of Europe's later Stone Period; and their lack of the artistic feeling and imitative faculty, so characteristic of the elder race, adds confirmation to this opinion.

Artistic sympathies, and a capacity for high achievements in painting and sculpture, are neither the direct results of civilization, nor in many cases the product of culture and

[1] Trans. Ethnol. Soc. N. S. iii. 227.

training. From the days of Giotto, the shepherd boy, to those of Thorwaldsen, Wilkie, and Turner, art is not only seen to be a direct and exceptional gift of nature, but it is frequently the product of a singularly partial intellectual development. Leonardo da Vinci and Michael Angelo are examples of men of rare and comprehensive genius, who sought in art the form in which to give expression to their many-sided powers. But, on the other hand, instances are not rare of artists like Thorwaldsen or Turner, who, except within the range of their own special art, seemed exceptionally defective in the exercise of ordinary mental powers. The same is true of races as of individuals. Some show an aptitude for art wholly wanting in others, who nevertheless equal or surpass them in more important qualities. The æsthetic faculty may, indeed, be described as curiously capricious in its manifestations. The Papuans of New Guinea and of New Caledonia, a race of Negrillos, in some points presenting analogies to the Australian, are nevertheless remarkable for a seemingly instinctive ingenuity and aptitude for art. Mr. Wallace describes them as contrasting with the Malay race in the habitual decoration of their canoes, houses, and almost every domestic utensil, with elaborate carving. The Fijians, who are allied to this Negrillo race, present in many respects an unfavorable contrast to the true Polynesian. In their physiognomy and whole physicial aspect, they are inferior to other island races of the Pacific; and are further notable for repulsive habits, and a general condition of social and moral degradation. But their ferocity, and the cruel customs in which they so strikingly differ from the Malays, are vices of a vigorous race. They have frequently been observed to indicate energy capable of being directed to useful ends; as is the case with the Maori cannibals of New Zealand, and was seen of old in the Huns and the Northmen of Europe, whose descendants are now among its most civilized nations. It is obvious, at any rate, that the savage vices of the Fijians are perfectly compatible with considerable skill in such arts as pertain to their primitive condition. Their musical instruments are superior to those of the Polynesians, and include the pan-pipe and others unknown in the islands beyond their range. Their pottery exhibits great variety of form; and some of the vessels combined in groups present a curious correspondence to familiar examples of Peruvian art. Their fishing-nets and lines are remarkable for neat and skilful workmanship, and they carry on agriculture to a considerable extent. "Indeed," remarked the ethnologist of the United States Expedition, in summing up the characteristics of the Fijians, "we soon began to perceive that the people were in possession of almost every art known to the Polynesians, and of many others besides. The highly-finished workmanship was unexpected, everything being executed until recently, and even now for the most part, without the use of iron. In the collection of implements and manufactures brought home by the Expedition, the observer will distinguish in the Fijian division something like a school of arts for the other Pacific islands."

All this has to be kept in view, in any attempt to gauge the intellectual development, or determine the degree of civilization of the palæolithic draftsmen and carvers of the Garonne. One of the scenes introduced by M. Figuier, in the fanciful illustrations of his "L'Homme primitif," represents a group of artists, such as, except for their costume, might have been sketched from the students of the Ecole des Beaux-Arts. Their mode of work was probably much more akin to the intermittent labours of the Indian, whose elaborately sculptured pipe is thrown aside, and resumed again—often after prolonged intervals—before it receives the finishing touch. But though the drawings and the carv-

ings of those primitive artists alike manifest remarkable skill and observant imitation, the former are the objects of special interest. Their carvings appear to have been executed, with rare exceptions, for the decoration of favourite implements and weapons, in accordance with a practice common to many diverse races and conditions of society. But the drawings have no such motive. They more nearly correspond to the sketch, or drawing from nature, of the modern artist; and furnish evidence of peculiar attributes, strikingly distinguishing the race of that remote age from most others that have succeeded them.

Certain it is that, so far as present evidence goes, the greatly prolonged Neolithic Period was characterized by no such artistic feeling or imitative skill. Specimens of the ingenious handiwork of the artificers of Europe's later Stone Age abound. We have numerous relics from the kitchen-middens of Denmark, the pile-villages of Switzerland, the crannoges of Scotland and Ireland; as well as all the varied contents of cromlechs, cists, cairns and barrows, diligently explored throughout Europe. But no such examples of carvings, or graven representations of animals or other natural objects, have been found. The "clay in the hands of the potter" is a familiar symbol of plastic response to the will of the designer. It is, indeed, easier for the practised modeller to fashion the clay into any desired form, than to draw it, subject to rules of perspective, on a flat surface. Linear devices and the representation of objects in intaglio, or in low relief, are also accomplished with great facility on the soft clay. Hence the art of diverse races, periods, and stages of progress, finds its aptest illustration in fictile ware; and the imitative faculty of widely different American races may be studied in their pottery. In Mexico, apparently, we have to look for the northern school of ceramic art. There, the aggressive races of the North first came in contact with the civilization of Central America; and the native aptitude for imitative representation received a fresh impulse. The Indian modeller learned to work skilfully in clay; and the variety of design, combined with the quaint humour of the caricaturist, displayed in many of the Mexican terra-cottas, serves to indicate this class of work as specially significant in relation to the present enquiry. The inventive fancy and skill of the Peruvian potter illustrates in ampler variety the progress achieved by the races of the southern continent. But this will more fitly come under review along with other examples of modern native art. For no analogous traces of contemporary modelling in clay furnish material for comparison with the art of the Palæolithic Era; though the skill of its bone and ivory carvers was in no degree inferior to that of the Mexican or Peruvian modeller. But the æsthetic aptitude of that old race of Europe's intellectual dawn is in some respects unique. In so far as their ingenious arts furnish any evidence of true racial characteristics, the men of the Neolithic Era inherited none of their æsthetic feeling; nor did the imitative faculty manifest itself in enduring form until the advent of the Aryan races brought with it the potentialities of Hellenic inspiration.

The absence of nearly every trace of imitative art in the prehistoric remains of Britain has already been noted. It made a strong impression on my mind at an early stage of my archæological researches; for this characteristic of European art extends over a period of greatly prolonged duration, marked by the advent and disappearance of races, dissimilar alike in physical and mental characteristics. We have the laboriously finished implements of neolithic art, the pottery of at least two distinct races seemingly prior to the Celts, and then the graceful artistic productions of the Bronze Period, but still only the

rarest traces of any effort at imitation. Thirty-four years ago, when the primitive arts of the American continent were only known to me from description, I remarked, of the archaic art of the first British metallurgists: "The ornamentation consists, almost without exception, only of improvements on the accidents of manufacture. The incised decorations of the pottery appear, in many cases, to have been produced simply by passing twisted cords round the soft clay. More complicated designs, most frequently consisting of chevron, saltire, or herring-bone patterns, where they are not merely the results of a combination of such lines, have been suggested, as I conceive, by the few and half-accidental patterns of the industrious female knitter. In no single case is any attempt made at the imitation of a leaf or flower, of animals, or any other simple objects."[1] At the date of those remarks the art of Europe's Palæolithic Era had still to be disclosed; but, with the arts of other primitive races, and especially those of the American continent, in view, I then added: "It is curious, indeed, and noteworthy, to find how entirely every trace of imitative art is absent in British archaic relics; for it is by no means an invariable characteristic of primitive arts." Dr. Hoffman, when commenting on aboriginal American art among the Indians of California, adds: "I have not met with any attempts at objective drawings or etchings which may be attributed to the Tshuma Indians, who were the former occupants of the island;[2] but ornamentations upon shells and bone beads, soapstone pipes, shell pendants, and other ornaments, seem to consist entirely of straight or zigzag lines, cross lines, circles, etc." The earliest examples of native metallurgy in Britain are to be found, I believe, in the works of the primitive goldsmith; but the same conventional and arbitrary ornamentation which occurs on early pottery, is equally characteristic of the beautiful personal ornaments of gold belonging, for the most part, to the first period of working in metals; and it is not till a late stage of the European Bronze Period that imitative art reappears, and zoomorphic decorations become common.

The discovery in 1868, and subsequent years, of numerous specimens of the artistic ability of the cave-men of palæolithic Europe, revealed a singularly interesting phase of primitive history. Remains of the so-called "Reindeer Period" are now familiar to us from many localities; for the range of this animal in palæolithic times appears to have extended from the Baltic to the Pyrenees. But a special interest was conferred on the first disclosures by the locality itself, where the Vézère, an affluent of the river Dordogne, winds its way through the cretaceous limestone, in which occur numerous caves and rock-shelters, rich in remains of primitive art. In this region of south-western France, where many historical and legendary associations carry the fancy back to elder centuries, the Dordogne unites with the Garonne at its estuary below Bordeaux. The upper waters of the Dordogne form the boundary between Limousin and Auvergne, and the Vézère is one of its highest tributaries in Limousin. There, nearly in the latitude of Montreal, but with the genial climate which, throughout the whole historic period has characterized southern France, lie the caves of Cro-Magnon, La Moustier, Gorge d'Enfer, Laugerie Haute and Basse, and La Madelaine, the long-sealed art galleries of prehistoric Gaul. The reindeer and the aurochs haunted its forests; the woolly rhinoceros and the mammoth still frequented its glades; and the long-extinct fossil horse was not only an object of the chase, but

[1] Prehistoric Annals of Scotland, i. 495.

[2] *i. e.* the Island of Santa Barbara. See "Remarks on Aboriginal Art," in Proc. Davenport Acad. Nat. Science, iv. 121.

was possibly already subdued to the companionship and service of man. Such, at least, is the idea suggested by a scene graven on the portion of a baton or staff, found by M. Lartet and Mr. Christy in La Madelaine cave, which represents a man between two horses' heads, apparently walking past, with a staff or spear over his shoulder. Nor were those man's sole contemporaries. The ferocious cave-lion and cave-bear disputed with the men of that period the occupation of the rock-shelters, where the latter employed their leisure as draftsmen and carvers, and so have transmitted to us graphic delineations of contemporary life, and no less significant indications of their own intellectual capacity.

The drawings of the ancient cave-men are of varying degrees of merit, showing the efforts of the unskilled tyro, as well as of the practiced artist. Some of the examples found at Laugerie Basse—as for instance, the assumed representation of an ibex, with its legs folded as if sitting,—are the crude efforts of unpractised draftsmen ; and would compare unfavorably with many examples of graphic art, the work of modern Eskimo and Indian gravers and draftsmen. But other specimens—such as the mammoth from La Madelaine cave, and the Alpine ibex and reindeers from Laugerie Basse, in Southern France, and, still more, the remarkably spirited drawing of the reindeer grazing, from the Kesserloch, near Thayingen, sketched on a piece of reindeer horn,—evince powers of observation, and a freedom of hand in sketching from nature, such as would be found exceptional among pupils of our best training schools of art. On this point my friend, Si rNoel Paton, writes me: "I entirely concur in your view as to the immense superiority as works of art of the engravings on horn and ivory found in the prehistoric caves, over any modern work of the same kind which I have seen, executed by the Eskimos or other savage tribes of our own day. As compared with the latter, the prehistoric productions are like the swift and direct studies from nature of Landseer, compared with the laboured scrawlings from memory of a rather dull schoolboy."

I have elsewhere drawn attention to the fact, that some of the drawings of the Perigord cave-men and their palæolithic contemporaries, and especially, among the latter, the Kesserloch sketch of a reindeer grazing, are left-hand drawings. So far as observation thus far extends, although the majority of those examples of primitive art suggest a preference for the use of the right hand, the percentage of left-hand drawings is much larger than could be looked for on any assumption that the use of the left hand is a mere exceptional deviation from the normal condition and functions of man. Here, at least, a family, or possibly a tribe, dwelt, among whom left-handedness prevailed to an unusual extent ; along with a degree of skill and dexterity, such as is frequently found to accompany the instinctive use of the left hand.

In this, as in other respects, the recovery of evidences of a well-developed æsthetic faculty among the men of Europe's Mammoth and Reindeer Period, furnishes materials for many suggestive inferences ; for we shall very imperfectly estimate the significance of the primitive drawings so unexpectedly discovered, if we regard them as no more than the pastimes of those ancient cave-men whose artistic ability they so unmistakably reveal. They are rather to be classed with the picture-writing of the American aborigines—including its most advanced Mexican stage abundantly illustrated in Lord Kingsborough's folios,—as one of the primitive supplements of language among uncultured races. As such it is a form of visible speech, and an important step in advance of the rude stage of gesture-language. The historical value of the palæolithic drawings is indis-

putable. They furnish a record, more trustworthy than any written chronicle, of the strange conditions of life, in a region familiar to us throughout the whole historic period for its genial climate and social civilization. It is in this aspect as a contemporary chronicling of current events,—a newspaper of the day,—that palæolithic art has its chief value. It furnishes a graphic picturing of the habits of life, and of many of the attendant circumstances of that remote period, recorded with such vivid truthfulness, that we realize very definitely the character of its long extinct fauna; and, to some considerable extent, the occupations and modes of life of the cave-men by whom they were hunted, and in leisure hours were reproduced graven or carved, on bone, horn or ivory, or traced in free outline on slabs of schist or other soft stone.

Viewed simply as examples of imitative art among a people still in the rudest Stone Age, the drawings are significant and instructive. They furnish evidence of observation and artistic capacity; and consequently of intellectual powers, capable of very different results from anything that could be realized in the absence of all knowledge of metallurgy, or of anything beyond the crudest appliances for developing mechanical skill. The conditions of climate probably forbade any attempt at agriculture. They were hunters, fowlers, fishers, subsisting mainly, if not wholly, by the chase. They not only successfully pursued the wild horse, the reindeer, and other swift-footed herbivora; but assailed the cave-bear, the cave-lion, and other formidable carnivora, as well as the huge rhinoceros and the mammoth. They also made excursions to the sea shore; and no doubt left there shell-mounds similar to those which have been explored with such interesting results on the Danish coast; and which have their New World equivalents on the sea-boards of Massachusetts, Georgia and Florida, where at certain seasons the Indians resorted to feast on the shell-fish. From their drawings and carvings we not only learn this, but also that they were not unfamiliar with the whale, the seal, and other marine fauna. The presence of the whale and seal in the same latitude as the reindeer need not surprise us. The occupation of Europe by palæolithic man contemporary with the *Elephas primigenius* and other extinct mammalia, belongs to an era when the relative levels of sea and land, and the relations of the Atlantic coast-line to the ancient continent, differed widely from their present conditions. If the genial current of the Gulf stream then reached the shores of Europe, its influence extended over areas very diverse from those now affected by it. But the range of the fauna of the Palæolithic Era was a wide one. Tusks of the mammoth and antlers of the reindeer occur in the Scottish boulder-clay; and the discovery of skeletons of the whale far inland in the carse of Stirling, accompanied in more than one case by harpoons made of perforated stag's horn, tells of the presence of the Greenland whale on the ancient Scottish sea coast, while the stag haunted its forests, and the allophylian savage paddled his canoe in estuaries marked for us now by old sea-margins that preceded the last great rise of the land. Skulls and horns of the elk occur in the Scottish peat bogs, seemingly indistinguishable from those of the *Cervus alces*, or North American moose.[1] As to the reindeer, not only are its remains found in Scottish mosses and the underlying marl, but they have been dug up in the ruined brochs, as at Cill-Trolla, Sutherlandshire, and Keiss in Caithness. The favourite haunts of the Greenland whale are in seas encumbered with floating ice; and when they were stranded in the estuary of the Forth by a tide

[1] Proc. Soc. Antiq. Scot. ix. 297, 301.

rising on a shore-line now nearly thirty feet above the tide mark of the present day, the highlands of Scotland were capped with perpetual snow, and great changes of level had still to occur. But neither the whale nor the Eskimo retreated within the Arctic circle because they could only be at home among polar ice and snow. Remains of the whale in Scottish kitchen middens of greatly more modern date, show that it must have haunted the Scottish shores when the temperature of the surrounding ocean differed little from that of the present day. There is preserved in the museum of the Scottish Antiquaries a drinking-cup fashioned from the vertebra of a whale, which was found in a weem, or subterranean dwelling, on the Isle of Eday, Orkney, along with implements of stone, horn, bone, bronze and iron; and other evidences of the presence of the whale in the Scottish seas are of frequent occurrence.

As to the ivory of the narwhal and the rostungr, or walrus, it was in use by Scoto-Scandinavian carvers at least as late as the presence of the reindeer in Scotland. A curious large sword, probably of the fourteenth century, at Hawthornden, near Edinburgh, has the hilt made of the narwhal's tusk; and the famous Lewis chessmen, found at Uig in the Isle of Lewis, as well as examples of chess and tablemen recovered from time to time in other localities in Scotland, are all made of the walrus ivory, the "huel-bone" of Chaucer. But when the whale haunted the shores to which the hunters of the Perigord resorted, the Atlantic coast-line, we have reason to believe, differed widely from its present aspect. It is doubtful if Britain was an island, in that age of the mammoth and the reindeer of the Pyrenees, when art flourished in the valley of the Vézère, and men, scarcely less strange than the long extinct fauna with which they contended and on which they preyed, sheltered in their rock-dwellings from the ice and snow of what is now familiar to us as the vine-clad sunny land of France. All this we learn from the archæological remains of those old times; and, especially in regard to the palæolithic hunters of Southern France, from the carvings and gravings which, happily for us, they executed, whether for pastime or as actual records. Like many of the native races of the American continent at the present day, they employed their leisure time in carving in bone, horn or ivory; and like them too, as we believe, they applied their skill in graphic art as a means of recording events and communicating facts to others. The broad palinated antlers of the reindeer, prepared sections of mammoth ivory, and slabs of schist, all furnished tablets on which they not only delineated the objects of the chase, but incidents and observations of their daily experience. And if so, we have in such drawings the pregnant germ of ideographic symbolism, and of hieroglyphic writing. By just such a process of recording facts in a form readily intelligible to others, the early dwellers in the Nile valley originated the mode of object-drawing and ideographic chronicling, from which hieroglyphic, demotic, and ultimately, phonetic writing were evolved.

It is not solely by inference, that we are led to surmise that the ingenious draftsmen of Southern France had a higher aim than mere pastime in some, at least, of their graphic devices. The relics recovered from the ancient caves include, along with the drawings, what appear to be tallies and numerical records, unmistakably indicative, not only of a method of numeration, but of the growth of a system of mnemonic symbolism, and distinctive graven characters, not greatly inferior to the primitive alphabets of Celtic or Scandinavian lithology. It is curious, indeed, to find in use in Europe's early post-glacial period symbols which, but for their undoubted execution by the ancient cave-men of

Aquitania, might be assigned with every probability to some Druid scribe, familiar with the ogham characters of the Gauls and British Celts. Among the objects recovered from the Dordogne caves, including tallies and inscribed tablets of horn and ivory, with their enumeration in simple units, M. Broca specially noted a deer's tyne, marked with a series of notches, which he assumed to be a hunter's memoranda of the produce of the chase. A more complex record, found in the rock-shelter of Gorge d'Enfer, is inscribed on a plate of ivory. Its groups of horizontal and oblique lines along the edges, and symmetrical rows of dots on the flat surface, combine to furnish a record graven in characters as well defined as many a runic or ogham inscription. If it be no more than the memoranda of a successful hunt, with a classification of the different kinds of game secured for distribution among the members of the tribe, it is not greatly inferior to the system of numeration among the Egyptians. But when such a piece of arithmetic was supplemented by a pictorial record of the hunt, or by the striking incident, so acceptable to a bevy of hunters over their campfire, of the fight of the male deer in the rutting season, or the charge of the enraged elephant with elevated trunk, trumpeting wrath and defiance, much had been accomplished that admits of comparison with the records of the modern penman.[1]

It is difficult for the men of a lettered age, with all the facilities of the printing-press in fullest use, to realize the condition of intellectual activity, or the natural modes of its expression, among an unlettered people. The transmission of Homeric or Ossianic poems, of a Niebelungen Lied or an Albanic Duan, from generation to generation, by the mere aid of memory, is scarcely conceivable to us now. Yet I recall the account of Ozahwahguaquzuebe, an Ojibway Indian, who told of his habitually accumulating his tobacco till he had saved enough to bribe an aged chief of the tribe to repeat to him, again and again, in all its marvellous details, the legend of Nanaboozo and the post-diluvial creation, in order that he might be able, in his turn, to recount it in full, as it had come down from elder generations of his people.

There are some results of the introduction of the printing-press still very partially appreciated. Its direct influence on social and intellectual progress receives ample recognition ; but not so all indirect influences traceable to its operations. In elder centuries, before Guttenburg and Faust superseded the labours of the scribe, not a few ballad-epics and lyrics were consigned to the wandering minstrels, to whose tenacious memories we are so largely indebted. But there were other avenues in those old centuries for fancy and passion, not greatly dissimilar to those by which the observation and descriptive powers of the post-glacial Troglodytes found vent. It is vain for a Pugin or a Ruskin to bewail the mechanical character of modern art. It was easier for the medieval satirist to find free scope for his humour in a sculptured corbel, or on a boss of the beautiful groined ceiling, or to carve his grosser caricature within easy access under the *miserere* in the choir, than to spend long hours at his lectern in the scriptorium, committing his fancies with laborious pains to less accessible parchments. And so, both satires and sermons were then graven in stone, which now find utterance in ways more suited to the age in which we live :

> "For nature brings not back the Mastodon,
> Nor we those times."

Taste and fancy have now a thousand avenues at their command for the humour and

[1] See Prehistoric Man, 3rd Ed., ii. 54.

satire which mingled, in quaint incongruity, with the devout aspirations inwrought into medieval architecture. With the revival of learning, and the introduction of the printing press, came the Renaissance. Europe renounced medieval art as "Gothic." Classic, or what passed for classic art, ruled for the next three centuries. Architecture became more and more mechanical; while æsthetic taste sought elsewhere, and more especially in the novel arena of the printing-press, for avenues where it could sport in unrestrained freedom.

The ingenious skill of the palæolithic artists and tool-makers, who wrought in their rock-shelters and limestone caves, in that remote era when the climate along the northern slope of the Pyrenees resembled that of our own Labrador coast at the present day, has naturally awakened a lively interest. The rigour of the climate during a greatly prolonged winter prevented their obtaining stone or flint for purposes of manufacture. They wrought, accordingly, in bone, in mammoth-ivory, and in the horn of the reindeer, fashioning from such materials their lances, fish-spears, knives, daggers and bodkins; turning to account the deer's tynes for tallies; and carving out of the larger bones what are assumed to have been maces or official batons, elaborately ornamented with symbolic devices designed for other purposes than mere decoration.

The Eskimo are recognised as presenting the nearest type to the cave-men of Europe's post-glacial era. It is even possible that, like the natives of Labrador, the latter may have occupied winter snow-huts; and only resorted to their cave-shelters during the brief heat of a semi-arctic summer. This, however, is rendered doubtful by the occurrence of reindeer horns and bones of young fawns, along with others of such varying age as to indicate the presence of the hunter during nearly every season of the year. Among a people so situated the industrial arts are called into constant requisition, alike for clothing and tools; and the experience of the hunter directs him to the produce of the chase for the easiest supply of both. The pointed horn of the deer furnishes the ready-made dagger, lance-head, and harpoon; the incisor tooth of the larger rodents supplies a more delicately-edged chisel than primitive art could devise; and the very process of fracturing the bones of the larger mammalia, in order to obtain the prized marrow, produces the splinters and pointed fragments which an easy manipulation converts into daggers, bodkins, and needles. The ivory of walrus, narwhal, or elephant is readily wrought into many desirable forms, and is less liable to fracture than flint or stone; and all those materials are abundant in the most rigorous winters, when the latter are sealed up under the frozen soil. Implements of horn or bone may therefore be assumed to have preceded all but the rudest flint celts and hammer-stones or unwrought missiles; and although, owing to the nearly indestructible nature of their material, it is from the latter that our ideas of primeval tool-making are chiefly derived, enough has been recovered from contemporary cave-deposits to confirm the analogy of their arts to those of the hyperborean workmen of our own continent.

The necessity which, to a large extent, determined the material of the ancient workers in bone and ivory, was favourable to the development of the imitative faculty. The ingenious ivory and bone carvings of the Tawatins and other tribes of British Columbia, the Thlinkets of Alaska, and the Eskimo, equally suffice with the examples of European palæolithic art, to show how favourable such material was to the development of artistic feeling, which must have lain dormant had the artificers been limited to flint and stone. The same influence may be seen in operation in many stages of art: as in the massive but

bald Gothic structures, such as St. Machar's cathedral on the Dee, where the builders were limited to granite; while contemporary architecture in localities where good sandstone or limestone abounds is rich in elaborate details; and where the soft and easily wrought Caen stone is available, runs to excess in the florid exuberance of its carvings.

The ingenious artist of the Palæolithic Era not only ornamented the hafts of his tools and weapons with representations of familiar objects of the chase; but also, as has been already noted, is accredited with carving, on his mace or baton, symbolic emblems expressing the rank and official duties of the owner. The analogous practice of the Haidas of the Queen Charlotte Islands at the present day shows that there is nothing inconsistent with primitive thought in the symbolic significance assigned to some of the carved batons; and, if so, we have there examples of imitative art employed in a way which involved the germ of ideographic graving or picture-writing. The mere fact of pictorial imitation implies the interpretation of its representations. Eskimo implements are to be seen in various collections, as at Copenhagen and Stockholm, in the British Museum, at San Francisco, and in the Smithsonian Institution at Washington, ornamented with representations of adventures incident to their habits of life. An Arctic collection presented by Captain Beechey to the Ashmolean Museum, at Oxford, furnishes interesting illustrations of the skill of the Eskimo draftsman. The carvings and linear drawings represent, for the most part, incidents in the life of the polar hunter; and this is so effectively done that, as Captain Beechey says: "By comparing one with another, a little history was obtained which gave us a better insight into their habits than could be elicited from any signs or intimations."[1] Mr. W. H. Dall figures in his "Alaska and its Resources," analogous examples of Innuit or Western Eskimo art; and in an interesting communication by Dr. J. W. Hoffman to the Anthropological Society of Washington, on Eskimo pictographs as compared with those of other American aborigines, he figures and interprets similar examples.[2] One of these, copied from an ivory bow used in making fire, which he examined in the Museum of the Alaska Commercial Company of San Francisco, depicts three incidents in the Innuit hunter's experience. In one, the hunter supplicates the *Shaman*, or native medicine-man, for success in the chase; another group represents the results of the chase; while the third records the incidents of an unsuccessful appeal to another shaman. Another graving from the same locality embodies the incidents of success and failure in a prolonged hunting expedition. In their interpretation, Dr. Hoffman was assisted by a Kadiack half-breed who happened to visit San Francisco at the time. A design of the same class copied from a piece of walrus ivory, carved by a Kiatégamut Indian of southern Alaska, records a successful feat of the shaman in curing two patients. He is represented in the act of exorcising the demons, who are seen just cast out from the men restored to health by his agency. From the interpretations thus given, it may be inferred that such drawings as those described by Captain Beechey represent in nearly every case actual incidents. The hunter celebrates his return from a successful chase, his experience in the attempt to propitiate the supernatural powers on his behalf, or any other notable event, by recording the impressive incidents on the handle of his hunting knife or his ivory bow, or even in some cases on a tablet of walrus ivory; just as the enthusiastic sportsman will at times

[1] Narrative of a Voyage to the Pacific, i. 241.
[2] Trans. Anthropol. Soc. Washington, ii. 140.

enter in his journal the special occurrences of the fox-hunt, or the more adventurous feats of deer-stalking, or commission an artist to perpetuate them on canvas. Incidents of exceptional skill or daring are no doubt recalled, and listened to with eager interest by the home circle in the Arctic snow-hut; and confirmed in their most thrilling details by appeals to such graven records.

The more durable material employed alike by the ancient cave-dwellers of Europe and by the modern Innuit and Eskimo, has secured their preservation in a form best calculated to command attention. But similar graphic representations of incidents and ideas are common to various tribes of North American Indians. Throughout the wide region of the old Algonkin tribes rock-carvings, such as that of the famous Dighton Rock, abound. The same are no less frequent in the south-west from New Mexico to California; while similar pictographs are executed by the Ojibwas in less durable fashion on their grave-posts, or even on strips of birch bark. In like fashion, the Crees and Blackfeet of our Canadian Northwest adorn their buffalo-skin tents with incidents of war and the chase; and blazon their buffalo robes with their personal feats of daring, and the discomfiture of their foes. In this way, the aboriginal draftsman is seen in his pictorial devices to be animated by a higher aim than mere pastime or decoration.

Of the ornamented handles of implements recovered from the abodes of the ancient cave-dwellers of Europe, the most notable examples are far in advance of any Eskimo carvings. One of those, from the cave at Laugerie Basse, has been repeatedly engraved. It is fashioned from a piece of reindeer's horn. The carver has so modified his design, and availed himself of the natural contour of his material, as to adapt it admirably to its purpose as the handle of a poignard. It was apparently intended to include both handle and blade; but probably broke in the process of manufacture, and was flung aside unfinished. The design is a spirited adaptation to the special requirements. The horns are thrown back on the neck, the fore legs doubled up, and the hind legs stretched out, as if in the act of leaping. Another finely finished example of a dagger-handle, from Montastruc, Peccadeau de l'Isle, figured by Professor de Quatrefages in his "Hommes fossiles," also represents the deer with its horns thrown back; but from its fractured condition the position of the limbs can only be surmised to have corresponded to the example from Laugerie Basse. With those may be classed such carvings as the pike so characteristically represented on a tooth of the cave-bear, recovered from a refuse heap in the cave of Durntly in the Western Pyrenees, and other similar sports of primitive artistic skill.

Such carvings had no other aim, we may presume, than the decoration of a favourite weapon, or the beguiling of a leisure hour. But they show the fruits of skill, and the observation of a practised eye, by the ingenious workmen whose drawings and etchings merit our careful study. Considerable taste and still more ingenuity are manifested by many of the aborigines of this continent, in their decorative carvings, and the ornamentation both of their weapons and dress. The characteristics of Eskimo art have been noted. The Thlinkets of Alaska, lying on their western border, manifest a like skill, making ladles and spoons from the horns of the deer, the mountain sheep, and goat; and carving them with elaborate ingenuity. They also work in walrus ivory, carving their bodkins, combs, and personal ornaments with varied ornamentation; decorate their knife-handles of bone, their paddles, and other implements; and carve grotesque masks, with much inventive ingenuity in the variety of the design, though scarcely in a style of high art. But it is

interesting to note the different phases of this imitative faculty. Some tribes, such as the Algonkins, confine their art mainly to literal reproductions of natural objects; while others, such as the Chimpseyans or Babeens, the Tawatins, and the Clalam Indians of Vancouver Island, have developed a conventional style of art, often exhibiting much ingenious fancy in its grotesque ornamentation. This is specially apparent in the claystone pipes of the Chimpseyans, in carving which they rival the ingenious Haidas of the Queen Charlotte Islands in exuberance of detail. But while the art has become conventional, where it is not displaced by imitations of the novel objects brought under their notice in their intercourse with Europeans, its native combinations are in most cases referable to Indian myths.

In many of the elaborately carved Chimpseyan pipes, their special purpose seems to be lost sight of in the whimsical profusion of ornament, embracing every native or foreign object that has chanced to attract the notice of the sculptor. Nevertheless, it may help us to do justice to the true aim of the Indian artist, if we call to remembrance how much of Christian symbolism was embodied in many a medieval sculpturing of what, to the unsympathetic observer, seem now only conventional vines and lilies, or a mere fanciful grouping of dragons and snakes, with apples, figs, grapes and thorns. This has to be kept in view while noting in the pipe-sculptures human figures in strangest varieties of posture, intertwined with zoomorphic devices, in which the bear and the frog have a prominent place, and, as will be seen, a mythic significance. It is no less suggestive to note, alike in the Chimpseyan and in the Tawatin and Haida carvings, curious analogies to the sculptures of Mexico, Yucatan and Central America. This resemblance has been noticed, independently, by many observers.

Marchand, a French navigator who visited the Queen Charlotte Islands in 1791, after having recently seen the Mexican sculpture and paintings, formed the opinion that the Haida works of art could be distinctly traced to Aztec origin.[1] He remarks of their paintings and carvings: "The taste for ornament prevails in all the works of their hands; their canoes, their chests, and different little articles of furniture in use among them, are covered with figures which might be taken for a species of hieroglyphics; fishes and other animals, heads of men, and various whimsical designs, are mingled and confounded in order to compose a subject. It undoubtedly will not be expected that these figures should be perfectly regular and the proportions in them exactly observed, for here every man is a painter and sculptor; yet they are not deficient in a sort of elegance and perfection."

The imitative faculty thus manifested so generally among a people still in the condition of savage life, shows itself no less strikingly in the modern clay-stone carvings of objects of foreign introduction. The collection formed by the United States Exploring Expedition, and largely augmented since, includes numerous carvings in which representations of log and frame houses, forts, boats, horses and firearms, are introduced; and where cords, pulleys, anchors, and other details copied from the shipping which frequent the coasts, furnish evidence of a practised eye, and considerable powers of imitation. To the unfamiliar observer, the result presents, in many cases, a very arbitrary and even incongruous jumble of miscellaneous details. But, most probably, the native designer had, in every case, a special meaning, and even some specific incident in view.

The interest awakened by such manifestations of observant accuracy and artistic skill

[1] Marchand's Voyages, ii. 282.

among savage tribes is not diminished by the fact that in nearly all other respects they are devoid of culture. Notwithstanding the absence in most of them of the very rudiments of civilization, experience proves that among the tribes to the west of the Rocky Mountains distinguished by artistic capacity, there is an aptitude for industrious and settled habits, the want of which is so noticeable in the nomad tribes of the prairies. Their linear patterns are often singularly graceful; and they employ colour lavishly, and with some degree of taste, in decorating their masks, boats and dwellings. This is specially noticeable among the Haidas, in the different dialects of whose language we find not only names for nearly all the primary colours, but also the word *kigunijago*, "a picture." The symbolical and mythological significance of many of their carvings is indisputable; while the affinities, traceable at times to the ornamentation most characteristic of the architectural remains in the principal seats of native American civilization in Central America, confer on them a peculiar interest and value.

The curiously conventional style of ornamentation of the Haidas of Queen Charlotte Islands is lavishly expended on their idols, or manitous, carved in black argillaceous stone, and on their council-houses and lodges. In front of each Haida dwelling stands an ornamented column, formed of the trunk of a tree, large enough, in many cases, to admit of the doorway being cut through it. These columns, or "totem-poles" as they have been called, are, in some cases, sixty or seventy feet high, elaborately carved with the symbols or totems of their owners. The height of the pole indicates the rank of the inmate, and any attempt at undue assumption in this respect is jealously resented by rival chiefs. The symbols of their four clans—the eagle, beaver, dog-fish, and black duck,—are represented in conventional style on the carved house-pole, along with their individual or family totems. In some cases boxes are attached to the poles containing the remains of their dead. Dr. Hoffman, whose previous studies in native symbolism and ideography specially prepared him for the intelligent observation of such monuments, has furnished an interpretation of their most familiar devices. "When the posts are the property of some individual, the personal totemic sign is carved at the top. Other animate and grotesque figures follow in rapid succession, down to the base, so that unless one is familiar with the mythology and folklore of the tribe, the subject would be utterly unintelligible. A drawing was made of one post with only seven pronounced carvings, but which related to three distinct myths. The bear, in the act of devouring a hunter or tearing out his heart, is met with on many of the posts, and appears to form an interesting theme for the native artists. The story connected with this is as follows:—Toivats, an Indian, had occasion to visit the lodge of the King of the Bears, but found him out. The latter's wife, however, was at home, and Toivats made love to her. Upon the return of the Bear, everything seemed to be in confusion. He charged his wife with infidelity, which she denied. The Bear pretended to be satisfied, but his suspicions caused him to watch his wife very closely, and he soon found that her visits away from the lodge for wood and water occurred each day at precisely the same hour. Then the Bear tied a magic thread to her dress, and when his wife again left the lodge, he followed the magic thread, and soon came upon his wife, finding her in the arms of Toivats. The Bear was so enraged at this that he tore out the heart of the destroyer of his happiness."[1] Dr. Hoffman found this myth, with the corresponding

[1] Remarks on Aboriginal Art in California and Queen Charlotte Islands, p. 118.

carvings in walrus ivory, among the Thlinkit Indians, who, as he conceives, obtained both the story, and the design for their ivory-carvings, from the Haidas. This appears to receive confirmation from the peculiar style of art common to both.

But the decorations of the Haida lodge-poles admit at times of a much more homely interpretation. Mr. James G. Swan, the author of an article on "The Haida Indians," in Vol. XXI of the "Smithsonian Contributions to Knowledge," in a communication to the *West Shore*, an Oregon journal, thus describes an Indian lodge and house-pole which attracted his notice, owing to its carved figures, in round hat and other European costume, surmounting the two corner posts of the lodge. He accordingly made a careful drawing of the whole, which, as he says, "is interesting as illustrative of the grim humor of an Indian in trying to be avenged for what he considered an act of injustice a number of years ago. Bear Skin, a somewhat noted Haida chief, belonging to Skidegate village, Queen Charlotte Islands, was in Victoria, when for some offence he was fined and imprisoned by Judge Pemberton, the police magistrate. Bear Skin felt very much insulted; and in order to get even with the magistrate he carved the two figures, which are said to be good likenesses of the Judge, who in this dual capacity mounts guard at each corner of the front of the chief's residence. The gigantic face on the front of the house, and the two bears on the two mortuary columns, seem to be grinning with fiendish delight, while the raven on top of one of the columns has cocked his eye so as to have a fair look at the effigies beneath him. Bear Skin is dead, but the images still remain. It has been suggested that they be removed to Victoria, and be placed over the entrance to the police barracks, to keep watch and ward like Gog and Magog at the gates of old London city." But, on the other hand, a symbolical meaning appears to be most frequently embodied in the Haida devices; of which Mr. Swan reproduces various illustrations, accompanied with native interpretations of them. One drawing, for example, represents a grouping of conventional patterns such as are common on the Haida blankets of goats' hair, and in which the untutored student can discern little more than confused scroll-work, with here and there an enormous eye, rows of teeth, and a symmetrical repetition of the design on either side of the central device. Yet, according to Kitelswa, the native Haida interpreter, "it represents cirrus clouds, or, as sailors term them, 'mares' tails and mackerel sky,' the sure precursors of a change of weather. The centre figure is T'kul, the wind spirit. On the right and left are his feet, which are indicated by long streaming clouds; above are his wings, and on each side are the different winds, each designated by an eye, and represented by the patches of cirrus clouds. When T'kul determines which wind is to blow, he gives the word and the other winds retire. The change in the weather is usually followed by rain, which is indicated by the tears which stream from the eyes of T'kul." The difficulty with which the inexperienced observer has to contend, in any attempt to interpret such native conventional art, finds apt illustration in Mr. Swan's account of an elaborately sculptured lodge-pole of which he made a drawing at Kioosta village, on Graham Island, one of the Queen Charlotte group. When describing it in minute detail, he says: "I could make out all the figures but the butterfly, which I thought at first was an elephant with its trunk coiled up; but on inquiry of old Edinso, the chief who was conveying me in his canoe from Massett to Skidegate, he told me it was a butterfly, and pointed out one which had just lit near by on a flower." The same characteristics have already been referred to in describing the claystone carvings of the Chimpseyans. They

also mark the Haida sculptures executed in the soft argillaceous slate which abounds in their vicinity. But the Haidas work with no less ability in other materials; and were familiar of old with the native copper, which is brought from some still unascertained locality, it is believed, in Alaska. The collections of the Geological Survey at Ottawa include some of their beautifully wrought copper daggers and a massive and finely finished copper neck-collar. They have now learned to work with equal skill in iron. Their bracelets, rings, and ear ornaments of gold and silver; their copper shields and richly carved emblematic weapons, bows and arrows, iron daggers and war knives; as well as their wooden and horn dishes, spoons, masks and toys, are eagerly sought after. The carvings on them, when properly explained, are of great interest: for every device has a meaning, and each illustrates a story or a legend, readily understood by the Indian, but by no means willingly interpreted to strangers.

A knowledge of the myths of the Haidas and other coast tribes is indispensable to any interpretation of their carvings; and to those, accordingly, Dr. Hoffman has directed his attention. "A very common object," as he says, "found carved upon various household vessels, handles of wooden spoons, etc., is the head of a human being in the act of eating a toad; or, as it frequently occurs, the toad placed a short distance below the mouth. This refers to the evil spirit, supposed to live in the wooded country, who has great power of committing evil by means of poison, supposed to be extracted from the toad;" but, as Dr. Hoffman adds, it is a difficult matter to get an Indian to acknowledge the common belief in the mythic being, even when aware that the enquirer is in possession of the main facts.

The interpretations thus furnished by a careful study of the carvings of the Haidas and other artistic native tribes of British Columbia, and the evidence of a specific meaning and application discoverable in their most conventional designs, have a significant bearing on the study of analogous productions of the cave-men of Europe's palæolithic dawn. The manifestations of an active imitative faculty and considerable amount of artistic skill, among different rude native tribes of this continent, present some striking parallels to the æsthetic aptitudes of the primeval draftsmen and carvers of Europe. There are moreover, undoubted resemblances in style and mode of representation of the objects, as depicted on some of the ancient and the modern bone and ivory carvings and drawings of the two continents; but the latter exhibit no evidence of progress. The Innuit and Eskimo designs do, indeed, more nearly approximate to those of the primitive draftsmen than other aboriginal efforts; but their inferiority in all respects is equally striking and indisputable.

The evidence of artistic ability in the native races both of Central and Southern America is abundant; nor is the Northern continent lacking in its specially artistic race. But the achievements of the ancient Mayas, Peruvians, or Mound-builders, are of very recent date, compared with the palæolithic, or even the neolithic productions of Europe. It need not, therefore, excite our wonder to find American antiquaries welcoming a disclosure, only too strikingly analogous to the famous mammoth drawing of the La Madeleine cave. There recently issued from the American press a tastefully printed volume, in which its author, Mr. H. C. Mercer, gives an account of the discovery, near Doylestown, Pennsylvania, of a "gorget stone" of soft shale, on which is graven what the author describes as "unquestionably a picture of a combat between savages and the hairy mammoth. The monster, angry, and with erect tail, approaches the forest, in which through the pine-

trunks are seen the wigwams of an Indian village." The sun, moon, and the forked lightning overhead, complete a design which could scarcely deserve serious notice, so palpable is the evidence of the fabrication, were it not for the unmistakeable sincerity with which the author sets forth the narration; and assures us that after the most careful inquiry "nothing has occurred to shake his faith in the unimpeachable evidence of an honest discovery."[1] The figure of the mammoth has a suspiciously near resemblance in all but one respect, to the La Madeleine graving on mammoth ivory. It charges its assailants with lowered trunk and erect tail; but instead of presenting, as in the ancient cave-dweller's drawing, evidence of aptitude in the free use of the pencil or graving tool, the scratchings on the Lenape Stone are crude and inartistic, even if tried by the rudest standard of Indian art. It may, perhaps, be worth noting that—if the design has not been purposely reversed in order to evade comparison with the genuine European example,—it is a left-handed drawing. The forgery of palæolithic implements has become a systematic branch of manufacture in Europe; and the "Grave Creek Stone," the "Ohio Holy Stone," and other similar productions of perverted American ingenuity are familiar to us. It need not, therefore, excite any special wonder to find a like activity in the production of fictitious examples of pictorial art.

But North America has its own ancient artistic race, which, though claiming no such antiquity as that of Aquitaine, is in the primary sense of the term, essentially prehistoric. Among the æsthetic productions of older races of this continent, the carvings and sculptures of the Aligéwi, or ancient Mound-builders of Ohio, not only admit of comparison with those of Europe's primitive workers in bone and ivory, but even, in one respect, surpass them. For it is curious to observe that the palæolithic artists, whose carvings and drawings manifest such a capacity for appreciating the grace of animal form, and for reproducing with such truthfulness objects and scenes familiar to them in the chase, seem to have invariably failed, or at least shown a surprising lack of skill, in their attempts to delineate the human face and figure. Professor de Quatrefages notes of one such carving: "M. Massénat has brought from Laugerie Basse a fragment of reindeer's horn, on which is graven a male aurochs fleeing before a man armed with a lance or javelin. The animal is magnificent; the man, on the contrary, is detestable, devoid alike of proportion and true portraiture."[2] Some beautiful Mexican terra-cotta human masks have been preserved; and, amid the endless varieties of quaint and whimsical device in Peruvian pottery, singularly graceful portrait-vases occur. But, as a rule, even among the civilized Mexicans, imitations of the human face and figure seldom passed beyond the grotesque; and, although the sculptors of Central America and Yucatan manifested an artistic power which accords with the civilization of a lettered people: yet, in the majority of their statues and reliefs, the human form and features are subordinated to the symbolism of their mythology, or to mere decorative requirements. In the carvings of the old Mound-builders, as in those of of the vastly more ancient artists of palæolithic Europe, we have to deal with miniature works of art; but both include productions meriting to be so designated. The variety and expressiveness of many of the mound-sculptures their careful execution, and the evidence of imitative skill which they furnish, all combine to render them objects of interest.

[1] The Lenape Stone, or the Indian and the Mammoth: by H. C. Mercer. New York, 1885, pp. 5, 17.

[2] Hommes fossiles et Hommes sauvages, p. 49.

But foremost in every trait of value are the human heads. In view of the accuracy of many of the miniature sculptures of animals, it has been reasonably assumed that they perpetuate no less trustworthy representations of the workmen by whom they were carved. Equally well-executed examples of contemporary portraiture, recovered from palæolithic caves of Europe, would be prized above all other relics of its Mammoth or Reindeer Period. Nevertheless, striking as is the character of the art of the Aligéwi, it differs only in degree of merit from that of many modern Indian races; and in some of the Algonkin stone-pipes the human figure is carved with well-proportioned symmetry. In such carvings, moreover, even when expended on the decoration of the pipe,—which was employed among so many native tribes of this continent in their most important ceremonial and religious observances,—there is rarely anything to suggest a higher aim of the artist than mere decoration. The same may be assumed of the ancient carvers, in such work as they expended on the hafts of the daggers found at Montastrue or Laugerie Basse. But when a carefully executed linear drawing occurs on a rough slab of schist, with its fractured edges left untrimmed, as is the case in examples from the caves of Les Eysies and Massat, the artist manifestly had some other purpose in view; and this I conceive to have been the earliest stage of ideography or picture-writing.

Language is even now a very inadequate means of communicating to others specific ideas of form; and some of the most fluent and versatile lecturers in those departments of science, such as geology, biology, and anthropology, in which there is a frequent demand for the appreciation of details in form and structure, habitually resort to the chalk and blackboard. Students of my own earlier days will recall, as among their most pleasant memories, the facile pencil with which the gifted naturalist, Edward Forbes, seemed equally eloquent with hand and tongue; and no one who has enjoyed the lucid demonstrations of Agassiz in the same fields of scientific research can think of him otherwise than with chalk in hand. To the uncultured, yet strangely gifted Troglodyte of the primeval dawn, language was still more inadequate for his requirements; and hence, as I imagine, the facile pencil was in frequent requisition for purposes of demonstration, with ever growing skill to the practised hand. Professor de Quatrefages, who has enjoyed unusually favourable opportunities for the study of those productions, thus directs attention to their artistic merits: "The art of the draftsman, or rather of the engraver, almost constantly applied to the representation of animals, was first tried on bone or horn. They have attempted it on stone. The burin must have been almost always a mere pointed flint. With this instrument, imperfect though it was, the Troglodytes of the Reindeer Age succeeded by degrees in producing results altogether remarkable. The first lines are simple and more or less vague. At a later stage they become more defined, and acquire a singular firmness and precision: the principal lines become deeper; details, such as the fur and mane, are indicated by lighter lines, and even the shading is expressed by delicate hatching. But what is nearly always apparent is a sense of truthful realization, and the exact copying of characteristics which enable us often to recognize not only the order, but the precise species, which the artist wished to represent. The bear, engraved on a piece of schist which was found by M. Garrigou in the lower cave at Massat, with the characteristic projecting forehead, can be no other than the cave-bear, the bones of which were recovered by that observer in the same place. When we compare the drawings and anatomical details of the Siberian mammoth with the engraving on ivory discovered by

M. Lartet at La Madeleine, it is impossible to avoid recognizing the *Elephas primigenius* which existed throughout the glacial period, and which has been recovered entire in the frozen soil of northern Asia. Oxen, wild goats, the stag, the antelope, the otter, the beaver, the horse, the aurochs, whales, certain species of fish, etc., have been found recognizable with the like certainty. The reindeer especially is frequently represented with remarkable skill. This may be seen by the engraving found near Thayingen, in Switzerland." [1]

M. de Quatrefages is disposed to estimate the artistic merit of the carvings in ivory as even greater than that of the drawings or etchings. But specific form and contour are more easily realizable than their indication on a plane surface. To do full justice to the wonderful skill of the Troglodyte draftsman, we must compare the most highly finished paintings on Egyptian temples and tombs with the works of their sculptors; or even the perfect realizations of the Greek sculptors' chisel, with drawings on the most beautiful Hellenic vases. The mastery of perspective as shown in some of the works of those palæolithic artists is remarkable when compared, for example, with the Assyrian bas-reliefs; not to speak of the infantile efforts of the Chinese on their otherwise justly prized ceramic ware.

The potter's art is at all times an interesting study to the archæologist. We owe to Etruscan and Hellenic fictile ware our sole knowledge of painting, contemporary with the most gifted masters of the sculptor's art. But it is in the form, rather than the decoration, that the chief excellency of the art of the potter consists. It is one of the plastic arts. The clay in the hands of the skilled modeller is even more facile than the pencil of the draftsman; and the distinction between the purely decorative sports of an exuberant fancy, and the purposed symbolism of the carver or painter, is nowhere more strikingly manifest than in the modellings of the ingenious worker in clay. But fictile art belongs, for the most part, to periods greatly more recent than that of the ancient Stone Age. Not that the work of the primitive potter involved such laboriously accumulated skill as lay beyond reach of the palæolithic carver and draftsman; for clay cylinders from the banks of the Euphrates, and the terra-cottas from the Nile valley, carry us back to times that long antedate definite history. But alike among the ancient cave-dwellers of Aquitaine, and the modern Eskimo, the prevailing conditions of an arctic or semi-arctic climate rendered clay, fuel, and other needful appliances, so rarely available, that among the latter, their pots and lamps are fashioned for the most part of the *Lapis ollaris*, or potstone. But traces of the pottery of many periods and races abound, and furnish interesting materials for comparison. The aptitude of the potter's clay for a display of skill, alike in modelling and in tracing on the surface imitative designs and ornamental patterns, renders the fictile ware of widely different eras a ready test of æsthetic feeling, as well as a trustworthy guide to the age and race of its artificers. To the ancient cave-men to whose skill such carvings as the reindeer from Laugerie Basse, or Montastrue, are due, modelling in clay would have been as easy and natural as to the modern sculptor; and pottery, if well burnt, when not exposed to violence, is little less durable than flint or stone. The rarity, or total absence, of pottery among the contents of the palæolithic caves accords with other indications of a rigorous climate. A piece of plain earthenware was, indeed, recovered from the Belgian cave of Trou de Frontal; and Sir W. Dawson, in his "Fossil Men," calls

[1] Hommes fossiles, etc., p. 46.

attention to the discovery, recorded by Fournal and Christie, of fragments of pottery in the mud and breccia of caverns in the south of France, along with bones of man and animals, including those of the hyæna and rhinoceros. Those, however, whatever be their true epoch, are mere potsherds, valuable in so far as they indicate the practice of the potter's art at such a time, but furnishing no illustration of skill in modelling.

The pottery found in graves of the Neolithic Period is mostly so imperfectly burned, that, however abundant it may have been, it could scarcely leave a trace in the breccia, or river gravel, from which the larger number of relics of palæolithic man have been recovered. But the pottery and terra-cottas which abound on the sites of Indian villages in North America, everywhere exhibit traces of imitative art, in the efforts at modelling the human form, and the more or less successful reproduction of familiar natural objects. Mr. Squier remarks in his "Aboriginal Monuments of the State of New York," that "upon the site of every Indian town, as also within all of the ancient enclosures, fragments of pottery occur in great abundance. It is rare, however, that any entire vessels are recovered. . . . In general there was no attempt at ornament; but sometimes the exteriors of the pots and vases were elaborately, if not tastefully, ornamented with dots and lines, which seem to have been formed in a very rude manner with a pointed stick or sharpened bone. Bones which appear to have been adapted for the purpose are often found."[1] Ornamentation of a more artistic kind appears to have been most frequently reserved by the native workers in clay for their pipes, to which at times a sacred character was attached, and on which accordingly they lavished their highest skill as modellers and carvers. Some of the smaller articles of burnt clay, however, which Mr. Squier denominates terra-cottas, were probably fragments of domestic pottery similar to those hereafter described among the relics of the ancient Indian town of Hochelaga. One example of an ingeniously modelled pipe, found within an enclosure in Jefferson County, New York, is specially selected as a good illustration of Indian art. It is of fine red clay, smoothly moulded, with two serpents coiling round the bowl. "Bushels of fragments of pipes," he adds, "have been found within the same enclosure." A carved stone pipe, from a grave in Cayuga County, is described as fashioned in the form of a bird with eyes made of silver inserted in the head; and Mr. Squier notes of another specimen: "The most beautiful terra-cotta which I found in the State, and which in point of accuracy and delicacy of finish is unsurpassed by any similar article which I have seen of aboriginal origin, is the head of a fox. The engraving fails to convey the spirit of the original, which is composed of fine clay slightly burned. It seems to have been once attached to a body, or perhaps to a vessel of some kind. It closely resembles some of the terra-cottas from the mounds of the west and south-west. It was found upon the site of an ancient enclosure in Jefferson County, in the town of Ellisburg." Again in describing some similiar relics from the site of an old Seneca village in Monroe County, he adds: "The spot is remarkable for the number and variety of its ancient relics. Vast quantities of these have been removed from time to time. Some of the miniature representations of animals found here are remarkable for their accuracy."[2]

The descriptions thus furnished of the traces of aboriginal art in the State of New York closely correspond to the remains recovered on the sites of ancient Indian villages in Canada. A finely modelled clay-pipe, with a serpent twined round it, and holding a

[1] Smithsonian Contributions to Knowledge, ii. 75. [2] Aboriginal Monuments, etc., p, 76.

human head in its jaws, now in my possession, was dug up, along with numerous other clay-pipes, bone pins, and other relics, in Norfolk County, on the north shore of Lake Erie. I also possess casts of some ingeniously modelled clay-pipes found a few years since in an ossuary at Lake Medad, near Watertown, about ten miles west from Hamilton, Ontario. This no doubt marks the site of an ancient town of the Attiwendaronks, or Neuter Nation, who were finally conquered and driven out by the Iroquois in 1635, when the little remnant that survived was adopted into the Seneca nation. Mr. B. E. Charlton, who explored the Lake Medad ossuaries, after describing the human remains, along with large tropical shells, shell-beads and other relics, adds : "With these were found antique pipes of stone and clay, many of them bearing extraordinary devices, figures of animals, and of human heads wearing the conical cap noticed on similar relics in Mexico and Peru."[1] Similar discoveries rewarded the researches of Dr. Taché in the Huron ossuaries on the Georgian Bay, examples of which are now in the museum of Laval University.

On the site of the famous Indian town of Hochelaga, the precursor of the city of Montreal, detached fragments, in well-burnt clay, including modellings of the human head and neck, had been repeatedly found, before the recovery of larger portions of the Hochelaga pottery showed that projections modelled in this form within the mouths of their earthern pots or kettles were designed to admit of their suspension over the fire. Any projection within the mouth of the pot, would have answered the purpose of protecting the cord or withe from the risk of burning ; so that the moulding of it into the human form furnishes an illustration of the play of the imitative faculty under circumstances little calculated to call it forth.

The decoration of domestic pottery by the American Indian workers in clay is greatly developed among the more southern tribes. The ornamentation of a few prominent points, moulded more or less rudely into human or animal heads, gives place with them to the modelling of the vessel itself into animal forms, or to its decoration, chiefly with human or animal figures. Among the examples of native art in the National Museum at Washington are two large vases, remarkable for their elaborate workmanship, which were brought from Mexico, by General Alfred Gibbs. They are figured, along with other specimens of Mexican pottery and terra-cottas, in Mr. Charles Rau's account of the Archæological Collection of the United States National Museum. They are there spoken of as "two large vases of exquisite workmanship," and one of them is not only described as an admirable specimen of Mexican pottery, but it is added : "As far as the general outline is concerned, it might readily be taken for a vessel of Etruscan or Greek origin. The peculiar ornamentation, however, stamps it at once as a Mexican product of art ;"[2] and, it may be added, in doing so, places it in very marked contrast to any example of Etruscan or Greek workmanship. Its modelling, both in general form and in all its curious zoomorphic details, is essentially barbarous, yet manifesting ingenious skill in the workmanship, and exuberent fancy in design. The influence of Mexican art extended northward ; and its characteristics may be traced in much of the native pottery of the Southern States. But throughout Mexico, Central America, and the Isthmus, the modeller in clay appears to have revelled in feats of skill. Clay masks and caricatures, and heads of men and animals, in endless variety of dress and fashioning, abound. Utility

[1] Proceedings of Hamilton Association, i. 54.

[2] Smithsonian Contributions to Knowledge, xxii. 82.

is in many cases rendered altogether subsidiary to the sports of fancy. Musical instruments are made in the form of animals; and vases and earthenware vessels of every kind are modelled in imitation of vegetables, fruits and shells, or decorated with familiar natural objects. This is still more apparent in Peruvian pottery, where an unrestrained exuberance of fancy sports with the pliant clay. Animal and vegetable forms are combined. Men and women are represented in their daily avocations, as porters, water-carriers, etc. Portrait-vases, represent the human head, characterized at times by grace and beauty; but more frequently grotesquely caricatured. The human head surmounts the lithe body of the monkey, sporting in ape-like antics; melons and gourds have animal heads for spouts; while the duck, parrot, toucan, pelican, turkey, crane, land-turtle, lynx, otter, deer, llama, cayman, shark, toad, etc., are ingeniously reproduced, singly or in groups, as models for bottles, jars or pitchers. The double or triple goblets, and two-necked bottles or jugs, acquire a fresh interest from resemblances traceable between some of them and others belonging to distant localities and remote ages. The Fijians, on the extreme western verge of the Polynesian archipelago, have already been referred to for their skill in the finished workmanship of their implements, and of their pottery, some of which suggest curious analogies to Peruvian types. But it is more interesting to note the apparent reproduction of Egyptian, Etruscan, and other antique forms in Peruvian fictile ware; and to recognize on the latter the Vitruvian scroll, the Grecian fret and other ancient classic and Assyrian patterns—not as evidence of common origin, but as originating independently from the ornamentation naturally produced in the work of the straw-plaiter and weaver. Still more curious are their analogies to ancient Asiatic art, as disclosed in a comparison with many of the objects recovered by Dr. Schliemann on Homeric sites. Among the relics which rewarded his exploration of the site of the classic Ilios, are examples of double-necked jugs, terra-cotta groups of goblets united as single vessels, along with others terminating with mouthpieces in the forms of human or animal heads; or modelled with such quaint ingenuity to represent the hippopotamus, horse, pig, hedgehog, mole and other animals, that were it not for the strange fauna selected for imitation, they would seem little out of place in any collection of Peruvian pottery.

The same exuberant sportiveness of the imitative faculty, so characteristic of the races of the New World, reappears in productions of the native metallurgists of Mexico and Central America. Casting, engraving, chasing and carving in metal, were all practised by the Mexicans with a lavish expenditure of misspent labour. Ingenious toys, birds and beasts with moveable wings and limbs, fish with alternate scales of gold and silver, and personal ornaments in many fanciful forms, were wrought by the Mexican goldsmiths with such skill, that the Spaniards acknowledged the superiority of the native workmanship over any product of European art. The ancient graves of the Isthmus of Panama have yielded immense numbers of gold relics of the same class, though inferior to the finest examples described above. They include beasts, birds and fishes, frogs and other natural objects, wrought in gold with much skill and ingenuity. The frog is made with sockets for the eyes, an oval slit in front, and within each a detached ball of gold, executed apparently in a single casting. Balls of clay are also frequently found enclosed in detached chambers in the pottery of the Isthmus. Human figures wrought in gold, and monstrous or grotesque hybrids, with the head of the cayman, eagle, vulture, and other animals, attached to the human form, are also of frequent occurrence; though in this

class of works the modelling of the human form is generally inferior to that of other animate designs. All of those curious relics are found in graves, which, judging from the condition of the human remains, are of great antiquity; if, indeed, they do not point to the central cradle, and common source of Aztec and Peruvian art.

It is thus apparent that the imitative faculty, which manifests itself in very different degrees among diverse races, was widely diffused throughout the native tribes of the American continent. But, while a certain aptitude for art is seen to be prevalent among some of the rudest tribes, there were, no doubt, among all of them exceptional examples of artistic ability. There were the Jossakeeds and the Wabenos, skilled in picturing on bark and deer-skin; and the official annalists or "Wampum-keepers," who perpetuated the national traditions. Among the arrow-makers were some famed for their dexterity in fashioning the horn-stone or jasper into arrow-heads; and, while the art of the potter proved no less easy to female hands than that of the baker, there were, doubtless, among them some few rarely-gifted modellers, whose skill in fashioning clay into favourite forms of imitative art won them a name among the ceramic artists of their tribe. Pabahmesad, an old Chippewa, whose dwelling in recent years was on the Great Manitoulin Island, in Lake Huron, was widely famed for his skill in pipe-carving. He was generally known among his tribe as *Pwahguneka*, the "pipe-maker," literally "he makes pipes." He was a thorough Indian in all his habits and feelings; and, though brought in contact with the Christian Indians of the Manitoulin Islands, he resisted the encroachments of civilization, and adhered to the creed and pagan rites of his fathers. It was even with reluctance that he turned to account any facilities derivable from tools of European workmanship in the exercise of his art. His materials were the *muhkuhda-pwahgunahbeck*, or black pipestone of Lake Huron; the *wahbe-pwahgunahbec*, or white pipestone procured on St. Joseph Island, and the *misko-pwahgunahbec*, or red pipe-stone of Coteau des Prairies. He condescended to turn the metal of European manufacture to account; but his saw, with which the stone was first roughly blocked out, had been made by himself out of a bit of iron-hoop, and his other tools were correspondingly rude. But his carved works show much ingenious skill; and he was unusually successful in his miniature sculptures of the human figure.[1]

The little remnant of the once powerful Huron race now settled at Lorette, near Quebec, expend their ingenious art on the manufacture of bark canoes, snow-shoes, lacrosse-clubs, basket-work, and mocassins. In this they show much skill and dexterity; but among their most adroit workers in recent years was Zacharee Thelariolin, who claimed to be the last full-blood Indian belonging to the band. He manifested great ability as an artist, had an apt faculty for sketching from nature, and painted in oil with considerable success. A portrait of himself, in full Indian costume, now in the possession of Mr. Clint of Quebec, is a relic of much interest as the work of an untaught native Indian, in whom the hereditary imitative faculty thus manifested itself under circumstances little calculated to favour its development. He was sixty-six years of age when he executed this portrait. Had it been his fortune to attract the attention of some appreciative patron in early years he might have made a name for himself and his people.

Another curious and exceptional example of native artistic ability may be noted here.

[1] See Prehistoric Man, 3rd Ed., Vol. i. Fig. 84.

The studio of Edmonia Lewis, the sculptor, has long been known to tourists visiting Rome. Her history is a curious one. Her father was a Negro, and her mother a Chippewa Indian. She was born at Greenbush, on the Hudson River, and reared among the Indians till the age of fourteen, both of her parents having died in her childhood. Her Indian name was *Suhkuhegarequa*, or Wildfire; but she changed it to that by which she is now known on being admitted to the Moravian school at Oberlin, Ohio. After three years schooling, she went to Boston, where, it is said, the sight of the fine statue of Franklin awoke in her the ambition to be a sculptor. She sought out William Lloyd Garrison, and in simple directness told him she wanted to do something like the statue of the printer-statesman. The great abolitionist befriended her. She received needful training in a local studio, started an *atelier* of her own, and when I saw her in Boston, in 1864, she was modelling a life-size statue emblematic of the emancipation of the race to which she, in part, belonged. Africa was impersonated, raising herself from a prostrate attitude, and, with her hand shading her eyes, was looking at the dawn. Soon after the sculptor went to Rome, and she has there executed works of considerable merit. Her most successful productions may be assumed to reflect the artistic aptitudes of her mother's race. Her two best works in marble are "Hiawatha's Wooing," and "Hiawatha's Wedding." A Boston critic, in reviewing her works, says: "She has always had remarkable power of manipulation, beginning with beads and wampum, and rising to clay. She has fine artistic feeling and talent, a sort of instinct for form and beauty demanding outward expression."

The wide diffusion of this imitative faculty and feeling for form, was no doubt stimulated by its employment for representative and symbolic purposes. The relation of imitative drawing to written language is equally manifest in the graven records of the Nile valley and the analogous inscriptions of Yucatan, or Peru. Quipus, wampum, and all other mnemonic systems, dependent on the transmission of images and ideas from one generation to another, literally, by word of mouth, have within themselves no such germ of higher development, as the picture-writing or sculpturing of the early Egyptians, from which all the alphabets of Europe have been evolved. The phonetic signs, inherited by us directly from the Romans, seem so simple, and yet are of such priceless value in their application, that it seems natural to think of the letters of Cadmus as a gift not less wonderful than speech; since, by their instrumentality, the wise of all ages speak to us still. Plutarch tells, in his "De Iside et Osiride," that when Thoth, the God of letters, first appeared on the earth, the inhabitants of Egypt had no language, but only uttered the cries of animals. They had, at least, no language with which to speak to other generations; nor any common speech to supersede the confusion of tongues which characterised their great river valley, bordering on Asia, and forming the highway from Ethiopia to the Mediteranean Sea. The light thrown for us on the climate, the fauna, the people, and the whole social life of Europe's Palæolithic Era, by a few graphic delineations of its primitive artists, suffices to show how the northern Thoth may have manifested his advent among them.

The condition of the Indian tribes in the Northwest, in British Columbia, and in the territories of the United States, abundantly illustrates the effect of a multiplicity of languages among nomad savages. The Blackfeet are in reality a political and not an ethnical confederation, with at least three distinct languages, and numerous dialects spoken among their dispersed tribes. The same condition is found among the Kiawakaskaia Indians, be-

yond the Rocky Mountains. In the confluence of the nomad hunters to common centres of trade, speech accordingly fails them for all purposes of intercommunication; and travellers and fur-traders have long been familiar with the growth of a common language at more than one of the chief meeting-places of diverse tribes and races on the Pacific coast. The Clatsop, in so far as it is native, is a dialect of the Cowlitz language; but, as now in use, it is one of the jargons or "trade languages" of the Pacific. But Fort Vancouver, long one of the largest trading posts of the Hudson's Bay Company, has been the special Babel where, out of the strangest confusion of tongues, a new language has been evolved.

The recent organization of part of the territory west of the Rocky Mountains into the province of British Columbia is rapidly modifying the character of its native population; and the change will be greatly accelerated on the completion of the Canada Pacific Railway. But in recent years there were frequently to be found at Fort Vancouver upwards of two hundred voyageurs with their Indian wives and families, in addition to the factors and clerks. Thither also resorted for trading purposes, Chinook, Nootka, Nisqually, Walla-walla, Klikatat, Kalapurgas, Klackamuss, Cowlitz, and other Indians. A discordant babel of languages accordingly prevailed; and hence the growth of a patois by which all could hold intercourse together. The principal native tribe of the locality is the Chinook, a branch of the Flathead Indians on the Columbia River. They speak a language rivalling that of the Hottentots in its seemingly inarticulate character. Some of its sounds, according to Dr. Charles Pickering, could scarcely be represented by any combination of known letters; and Paul Kane, who travelled as an artist among them, described it to me as consisting of harsh spluttering sounds proceeding from the throat, apparently unguided either by the tongue or lips. This language accordingly repelled every attempt at its mastery by others. The Cree is the native language most familiar to the traders, many of their wives being Cree women. Both French and English are spoken among themselves; while, in addition to the tribes already named, natives of the Sandwich Islands, Chinese, and other foreigners, add to the strange character and speech of this miscellaneous community. Out of all those elements the "Chinook jargon" or trade-language of the locality has fashioned itself.

Vocabularies of the Oregon, or Chinook jargon have been repeatedly published since 1838, when the Rev. Samuel Parker made the first attempt to reduce it to writing. But it is necessarily in an unstable condition, with local variations, and a changing vocabulary. The latest "Dictionary of the Chinook Jargon, or Trade-Language of Oregon," is that of Mr. George Gibbs, published by the Smithsonian Institution in 1863, and includes nearly five hundred words. When studied in all its bearings, it is a singularly interesting example of the effort at the development of a means of intercommunication among such a strange gathering of heterogeneous races. In an analysis of the various sources of its vocabulary, Mr. Gibbs assigns about two fifths of the words to the Chinook and Clatsop languages. But in this he includes one of the most characteristic elements of the jargon. The representatives of so many widely dissimilar peoples, in their efforts at mutual communication, naturally resorted to diverse forms of imitation; foremost among which was onomatopœia. There are such mimetic words as *hee-hee*, "laughter;" *hoh-hoh*, "to cough;" *tish-tish*, "to drive;" *lip-lip*, "to boil;" *poh*, "to blow out;" *tik-tik*, "a watch;" *tin-lin* or *ting-ling*, "a bell;" *tum-tum*, "the heart," from its pulsation; and hence a number

of modifications in which the heart is used as equivalent to mind or will, etc. Again, varying intonations are resorted to, in order to express different shades of meaning, as *sey-yaw*, "far off," in which the first syllable is lengthened out according to the idea of greater or less distance indicated. Many of their words, as in all interjectional utterances, depend for their specific meaning on the intonations of the speaker. Such utterances play so small a part in our own speech, that we are apt to overlook the force of the interrogative, affirmative, and negative tones, and even the change of meaning that is often produced by the transfer of emphasis from one to another word.[1] But with such an imperfect means of intercommunication as the trade jargon, there is a constant motive, not only to help out the meaning by expressive intonation, but also by signs or gesture-language. "A horse," for example, is *kuatan*; but "riding" or "on horseback" is expressed by accompanying the word with the gesture of two fingers placed astride over the other hand. *Tėnas* is "little" or "a child,"—in the latter case, accompanied by the gesture suggestive of its size,—or it may mean "an infant," by the first syllable being prolonged to indicate that it is very small. In addition to all this, words are borrowed from all sources; and the miscellaneous vocabulary is completed from English, French, Cree, Ojibway, Nootka, Chilhalis, Nisqually, Kalapuy, and other tongues.

The late Paul Kane, author of "Wanderings of an Artist in the North-west," is my authority for some of the details of intonation and gesture-language. He brought back with him a valuable collection of studies of the different races in British North America; and, by means of the jargon, he learned in a short time to converse without difficulty with the chiefs of most of the tribes around Fort Vancouver. But as an artist he was in constant use of his pencil; and, as he told me, he frequently appealed to it, sketching himself, or at times putting his pencil and note-book into their hands, with considerable success in thus supplementing less definite signs. The gesture-language furnishes Cheyenne, Dakota, Apache, and other signs for "paint, colour, draw," and "write;" the act of writing or drawing being expressed by holding up the palm of one hand and moving the forefinger of the other over it, as if drawing. The jargon has also its word *pent*, "paint," transformed to a verb by prefixing the word *mamook*, "to do, to make;" and its *tzum*, "painting," or "mixed colours;" *mamooktzum*, "to paint." In the gesture language of the Dakotas and Apaches the equivalent sign is primarily indicative of daubing the face with colour; but the tribes of the Pacific Coast paint their masks, boats, and houses in diverse coloured devices, with some degree of taste. There is, therefore, reason to look for terms expressive of the art in any language in use among them; though the habitual employment of signs may in some cases check the evolution of phonetic equivalents. But among many tribes gesture-language has been systematized into universally recognized pictographs, and so developed into a native system of hieroglyphics.

Among the Algonkin, Lenape, Iroquois, and other Northern tribes, and in the region comprising New Mexico, Arizona, Colorado, and other South-western territory, rock-carv-

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[1] The Rev. Mark Pattison, according to one biographer, Mr. Althaus, had cultivated a habit of reticence, till it became one of his most marked characteristics. His usual response to any remark was "Ah;" but his biographer adds: "It was interesting to observe of what a variety of shades of meaning that characteristic ejaculation 'Ah' was capable. Many times it was his sole answer. Mostly it signified that something had aroused his interest; sometimes it conveyed approval, sometimes surprise, sometimes doubt; sometimes it was said in a way that indicated he did not wish to express himself on the point in question."

ings and pictographs abound. Wherever large surfaces of rock, or slabs of stone, offer a favourable opportunity for such records, they are found, at times executed with great elaboration of detail. But less durable records are in use, dependent on the materials most available to the scribe. The Algonkins and Iroquois ordinarily resort to birch bark; the Crees, Blackfeet, and other prairie Indians, substitute the dressed skins of the buffalo; while, as already noted, the tribes on the Pacific Coast, as well as the Innuit and Eskimo, employ deer-horn, and ivory. In the South-west, in the Sierra Nevada and Southern California, the sculptured pictograph, after being incised on the surface of a rock, or the wall of a cave, is frequently finished by colouring in much the same way as was the custom with the ancient Egyptian chroniclers.

Among a series of reports to the Topographical Bureau, issued from the War Department at Washington, in 1850, is the journal of a military reconnoissance from Santa Fé, New Mexico, to the Navajo Country, by Lieutenant James K. Simpson of the Corps of Topographical Engineers. His narrative is accompanied with a map and illustrations of a remarkable series of inscriptions, engraved on the smooth surface of a rock called the Moro. They are of two classes, the native pictographs, and also numerous Spanish inscriptions and devices; one of which records the hasty visit of an old Spanish explorer to the Moro Rock in 1606. The route of Lieutenant Simpson lay up the valley of the Rio de Zuni, where he met an old trader among the Navajos, who was waiting to offer his services as guide to a rock, upon the face of which were, according to his repeated assertions, "half an acre of inscriptions." After travelling about eight miles, through a country diversified by cliffs of basalt and red and white sandstone, in every variety of bold and fantastic form, they came in sight of a quadrangular mass of white sandstone rock, from two hundred to two hundred and fifty feet in height. This was the Moro, or Inscription Rock, on ascending a low mound at the base of which, the journalist states, "sure enough here were inscriptions, and some of them very beautiful; and although, with those we afterwards examined on the south face of the rock, there could not be said to be half an acre of them, yet the hyperbole was not near as extravagant as I was prepared to find it." The inscriptions, some in Spanish, and others in Latin, apparently include examples nearly coeval with the conquest of this region, by Juan de Onate, in 1595; and from their historical interest they naturally received greater attention from the topographical corps than the Indian hieroglyphics. But the same locality was visited at a later date by surveyors appointed to ascertain the most practicable route for a railroad to the Pacific Coast; and in a Report of explorations and surveys, published by the Senate of the United States in 1856, Lieutenant Whipple furnishes an interesting series of Indian hieroglyphics or pictographs seen on his route. "The first of the Indian hieroglyphics," he remarks, "were at Rocky Dell Creek, between the edge of the Llano Estacado and the Canadian. The stream flows through a gorge, upon one side of which a shelving sandstone rock forms a sort of cave. The roof is covered with paintings, some evidently ancient; and beneath are innumerable carvings of footprints, animals, and symmetrical lines."[1] Examples of these are given; but of one series, the sketches of which had been lost, Lieutenant Whipple remarks: "This series, more than the others, seems to represent a chain of historical events, being embraced by serpentine lines. First is a rude sketch,

[1] Reports of Explorations and Surveys for route for a Railroad to Pacific Ocean, 1885. Part iii. p. 39.

resembling a ship with sails; then comes a horse with gay trappings, a man with a long speaking-trumpet being mounted upon him, while a little bare-legged Indian stands in wonder behind. Below this group are several singular-looking figures: men with the horns of an ox, with arms, hands and fingers extended as if in astonishment, and with clawed feet. Following the curved line we come to the circle, enclosing a Spanish caballero, who extends his hands in amity to the naked Indian standing without. Next appears a group with an officer, and a priest bearing the emblem of Christianity." The Pueblo Indians who still worship the sun, recognized in those picturings records of the thoughts and deeds of their ancestors. They pointed to representations of Montezuma, whom they still expect to return, and who is regarded as a divine power; and recognized in the horned men a representation of the buffalo-dance, from time immemorial a national festival at which they crowned themselves with horns and corn-shucks. The drawing is in all probability an historical record executed at a date not long subsequent to the first intrusion of the Spaniards.

Lieutenant Whipple next describes the carvings found at El Moro inscription rock where, he says, "Spanish adventurers and explorers, from as early a period as the first settlement of Plymouth, have been in the habit of recording their expeditions to and from Zuni." He refers for those to Captain Simpson's report upon the Navajo expedition; but specimens of the Indian drawings are given, which, he says, "are evidently more ancient than the oldest of the Spanish incriptions."[1] The latter are, for the most part, regular literal records in the Spanish or Latin language, with names, and, in a few instances, the date of their engraving. But the European epigraphists appear at times to have borrowed the ideographic art of their Indian guides, from the way several of their inscriptions are accompanied with pictorial devices, or rebuses, somewhat after the native fashion of writing. One, for example, which reads *Pito Vaca ye Jarde*, has also the symbol of the *Vaca*, or "cow." Another group, consisting of certain initials interwoven into a monogram, accompanied by an open hand with a double thumb, all enclosed in cartouch-fashion, is supposed by the transcriber to be, even more than the previous bit of pictorial symbolism, a pictured pun. "The characters," he remarks, "in the double rectangle seem to be literally a sign-*manual*, and may possibly be symbolical of Francisco Manuel, though the double thumb would seem to indicate something more." The Provincial Secretary, Donaciano Vigil, after noting for Lieutenant Simpson some data relative to the Spanish inscriptions, adds: "The other signs or characters are traditional remembrances, by means of which the Indians transmit historical accounts of all their remarkable successes. To discover (or interpret) these sets by themselves, is very difficult. Some of the Indians make trifling indications, which divulge, with a great deal of reserve, something of the history, to persons in whom they have entire confidence."

On the summit of the cliff the ruins of a pueblo of bold native masonry formed a rectangle of two hundred and six by three hundred and seven feet, around which lay an immense accumulation of broken pottery of novel and curious patterns. At Los Ojos Calientes, Lieutenant Simpson visited the *estuffas*, buildings one story high, called the churches of Montezuma. "On the walls were representations of plants, birds, and animals: the turkey, the deer, the wolf, the fox, and the dog, being plainly depicted; none

[1] Reports of Explorations and Surveys for route for a Railroad to Pacific Ocean, 1885. Part iii. p. 39.

of them, however, approaching to exactness except the deer, the outline of which showed certainly a good eye for proportion." These are the work of the Jemez Indians, who worshipped the sun, moon, and fire; representations of which in circular form, and with zigzag barbed lines for lightning, also occur on the walls.[1] Lieutenant Simpson remarks that he asked a Jemez Indian "Whether they still worshipped the Sun, as God, with contrition of heart." His reply was: "Why not? He governs the World!"

Dr. Hoffman figures and interprets a curious rock-painting, copied by him from a granite boulder at Tulare River, California. It covers an area of about twelve feet by eight; and the largest figure is about six feet in length, and appears to be the work of an advanced party of native explorers, intended for the guidance of those who followed on their trail.[2] Dr. Hoffman also furnishes some interesting illustrations of the reproduction of gesture-language in native pictographs preserved in the Museum of San Francisco. Certain symbols are in very general use. But the description of an Innuit drawing on a slat of wood, as interpreted by a native, partly in his own dialect, but largely supplemented by gestures, will best illustrate this development of a system of picture-writing among a savage people. A human figure directs his right hand to his own side, while, with his left, he points away from him. This is the *Ego*, the personal pronoun *I*. Again, a simple tracing of the like figure, successively with a boat-paddle over his head; his right hand to the side of his head; one finger elevated; his hand stretched out in the direction indicated, with his harpoon, or his bow and arrow, expresses his various actions. A spot enclosed in a circle, and again a blank circle, mark the islands—inhabited or uninhabited,—to which he is bound. A canoe, with two persons in it, defines the number going and the mode of transport; a phoca, or other animal, indicates the prey; and the record closes with an outline of the house, or tent, towards which the canoe is directed. The whole is equivalent to a written memorandum left behind, to inform the members of his family that he has gone in his boat to a particular island, where he will pass a night,—the right hand to the side of the head being a symbol of sleep. From thence he will proceed to another island, where he purposes to catch a seal or sea-lion, and then he will return home. It is in no degree surprising to find that nearly the same symbols are in use by widely different tribes; for, alike in their pictographs and gestures, they naturally aim at the most familiar and literal representations. The Eskimo and Alaskans represent death, in their drawings and bone carvings by the symbol of a headless body, in nearly the same way as the Iroquois, the Algonkins, and the Blackfeet. To this is added the spear, the bow and arrow, or the gun, to indicate the mode of death by violence. The ordinary symbol of sepulchral memorial is the reversing of the totem and other objects pictured on the grave-post. A succession of lines in rows or columns is the simplest mode of primitive numeration, perpetuated among the Egyptians even so late as the Ptolemaic dynasty. It appears to have been in use among the cave-men of the Vézère in palæolithic times, and is common to all such records. But in the Eskimo and Indian pictographs the elevated hand, with one or more fingers extended, serves for numeration; and where the extended fingers and thumbs of both hands are represented on an exaggerated scale, it signifies *multitude*. The native gestures, drawings, and spoken languages, have indeed

[1] Reports of Secretary of War, U. S., 1850, p. 67.
[2] Transactions of Anthropol. Soc., Washington, ii. 130.

to be studied together to understand fully the processes resorted to for the expression and interchange of ideas.

To the philologist, the efforts at supplying equivalent terms for objects and ideas common to the many diverse races furnish a study full of interest. A Chinook or Clatsop word modified to *saghalie*, signifying "above," or "high," is compounded with the Nootka *tyee*, as the name of the High Chief, or God. *Elip*, a Chihalis word, signifies "first," or "before;" *tilikum*, Chinook, is "people, a tribe," or "band;" but the two words conjoined, *elip-tilikum*, lit. "the first people," is employed in reference to a race of beings who preceded the Indians as inhabitants of the world, just as we speak of the Antidiluvians. *Ipsoot* is the Chinook word for "to hide," *ipsoot wau-wau* is "to hide one's speech," *i.e.*, "to whisper." Or, again, *opitsah* is a modification of the Chinook for "a knife;" *opitsah-yakka-sikha*, literally, "the knife's friend," is "a fork." The same word is also applied to a sweetheart. Such economic use of words is indeed common by no means rare. But this branch of the subject lies apart from the aim of the present paper. It may be noted, however, in passing, that many of the jargon words, according to Mr. Gibbs, "have been adopted into ordinary conversation in Oregon, and threaten to become permanently incorporated as a local addition to the English." Mr. Horatio Hale, long ago, stated as the result of his own observations, at an earlier date: "There are Canadians and half-breeds married to Chinook women, who can only converse with their wives in this speech; and it is the fact, strange as it may seem, that many young children are growing up to whom this factitious language is really the mother-tongue, and who speak it with more readiness and perfection than any other."[1] As to grammar, the jargon has no more than the inevitable rudiments involved in the necessity for expressing in some way ideas relating to time and number; and in these directions there is frequent resort to signs. But this, which accords with the first stage of picture-writing, is true of the speech of many Indian Tribes. Their gesture-language is being reduced to the equivalent of a vocabulary, and is much more copious than that of the Oregon Jargon. In 1880 the United States Bureau of Ethnology issued "A Collection of the gesture-signs and signals of the North American Indians;" and although this was only designed as a preliminary step towards the complete elucidation of the subject, it suffices to show how important a part signs and gestures play in the dialogue of many rude tribes. The Arapahoes, for example, according to Burton, "possess a very scanty vocabulary, and can hardly converse with one another in the dark. To make a stranger understand them they must always repair to the camp fire for pow-wow."[2] We are not without some due appreciation, even now, of the eloquence of action, as well as of speech, in the effective orator; and Charles Lamb, in one of the "Essays of Elia," aptly reminds us how much even ordinary dialogue owes to expression for its full effect. Candle-light, "our peculiar and household planet," is the theme of the quaint humourist. "Wanting it," he says, "what savage unsocial nights must our ancestors have spent, wintering in caves and unillumined fastnesses! . . . What repartees could have passed, when you must have felt about for a smile, and handled a neighbour's cheek to be sure that he understood it?" And so the grave humourist goes on to picture the privations of a supper party in "those unlanterned nights."

But the Indian, in many cases, resorts to the pencil, or its equivalent, for the elucida-

[1] United States Exploring Expedition, vii. 644.

[2] Burton's City of the Saints, p. 157.

tion of subjects in which language fails him. He will take a burnt stick and draw a map indicating the route that has to be taken, the portages on a river, or the trail through the forest, after he has failed by signs and gestures to convey his meaning; and he can interpret with ease the drawings of Indians of other tribes. When camping out on the Nepigon River in 1866, with Indian guides from the Saskatchewan, who were strangers to the locality, they interpreted the drawings or carvings on a soft metamorphic rock overlaid by the syenite of that district; and were able thereby to tell us who had preceded them, and to determine the route we should take. Lieutenant Whipple in the narration of his route near the thirty-fifth parallel, remarks: "Near the Llano Extacado were seen Pueblo Indians from San Domingo. After an introductory smoke they became quite communicative, furnishing curious information as to their traditions and peculiar faith. When questioned regarding the numbers and positions of the Pueblos in New Mexico, they rudely traced upon the ground a sketch from which a map of the country is reproduced in the Government Reports."[1] The Rev. Dr. O'Meara, for many years a missionary among the Ojibway Indians of Lake Superior, thus writes to me: "The Indians were always pictorial, even in common conversation, *i.e.*, they liked to explain what they meant by making figures; and always, if you asked one of them for information as to the route to any place, he would make a rough map of it, either on the sand or on a piece of birch bark." This fully accords with my own experience. I have repeatedly seen Indian guides take a piece of birch bark and indicate on it some idea otherwise inexpressible from our ignorance of any common language. Their map-making must be familiar to all who have travelled much with Indian guides. They delineate with much accuracy the leading geographical features of any familiar locality. I have in my note-books sketches made by Indians, when I have placed the pencil in their hand, and indicated by signs some information I desired to obtain, about game, fishing, or other matters familiar to them; or about their own tribal relationships, which they generally express in totemic fashion by their symbolic bear, deer, beaver, eagle, turtle, or other animal. Such signs of the clan, tribe, or nation are familiar to every Indian, as well as the ideographs of his own and others' names; and when represented on the roll of birch bark, painted on the chief's buffalo robe, or inverted on his grave-post, they can be interpreted with the same facility with which an heraldic student discerns the family history on the painted hatchment or the sculptured shields of some noble mausoleum.

By an alphabet, strictly so called, we understand a series of symbols which have become the conventional equivalents to the eye of the sounds which combine to form the speech of a people. But *alpha*, *beta*, etc., were undoubtedly, in their first stage, pictures, and not arbitrary signs; though they passed undesignedly into the demotic characters of the Egyptian current hand, and were then transformed, from ideographic and syllabic characters, into the true phonetics out of which have come the later alphabets of the civilized world. Egypt is justly credited with the origination of a system of writing which lies at the foundation of all our inherited knowledge, and which, as Bacon says, "makes ages so distant to participate of the wisdom, illuminations and inventions, the one of the other." Yet the germ of all this lay in the graphic records of the palæolithic cave-men; and the very same process of evolution from pure pictorial representation to pic-

[1] Explorations and Surveys, Washington, 1856, iii. 10, 36.

ture-writing or ideography, and so to arbitrary hieroglyphic signs, or word-writing, is seen in the graven records of Copan or Palenque, and on the ancient monuments of the Nile.

It is replete with interest for us thus to turn aside from the Old World, with all its wealth of intellectual progress associated with the letters of Cadmus, and find that in this western hemisphere the human mind has followed the very same path in its struggle towards the light. Longfellow, in his "Song of Hiawatha," has interwoven Algonkin and Iroquois legends into a national epic, in which the elements of Indian progress are all traced to this mythic benefactor, subsequently identified by Mr. Horatio Hale, in his "Book of Iroquois Rites," with a wise Onondaga chief of the fifteenth century. But, tracing in legendary fashion the early steps of Indian progress, the poet represents the mythic reformer mourning how all things perish and pass into oblivion. Even the great achievements and the traditions of their people fade away from the memory of the old men. And so he inaugurates the method of recording events, which in reality we recognize as the natural product of the human mind in the exercise of that imitative faculty which the discoveries of comparatively recent years have revealed to us as in full activity among the men of Europe's remote post-glacial era. With his paints of diverse colours he depicts on the smooth birch-bark simple figures and symbols, such as are to be seen graven on hundreds of rocks throughout the North American continent, and are in constant use by the Indian in chronicling his own deeds on his buffalo robe, or recording those of the deceased chief on his grave-post. The result is a simple process of picture-writing, readily translatable, with nearly equal facility, into the language of every tribe. Deeds of daring against Indians or white men are set forth by the native chronicler, and the rivals are clearly indicated by means of their characteristic costume and weapons. Headless figures are the symbols of the dead ; scalps represent his own special victims ; and in like manner incidents of the chase, or feats against the buffalo or grizzly bear, are recorded in graphic picturings, which are as intelligible as any monumental inscription of ancient or modern times. The description in Longfellow's Indian epic of the celestial and terrestrial symbols, in actual use as Algonkin and other aboriginal hieroglyphics, would answer, with slight modification, for those still to be seen on the walls of Egyptian temples and catacombs :

> "For the earth he drew a straight line,
> For the sky a bow above it ;
> White the span between for day-time,
> Filled with little stars for night-time ;
> On the left a point for sunrise,
> On the right a point for sunset,
> On the top a point for noontide ;
> And for rain and cloudy weather
> Waving lines descending from it."

The picture-writing of the Aztecs, though greatly improved in execution, and simplified by abbreviations, was the same in principle as that of the rude northern tribes. The recognized signs of the months and days of their calendar are not greatly in advance of Indian symbolism; while some of their pictorial records are as definite pieces of literal representation as the battle of the reindeer from the Dordogne cave ; or the peaceful grazing scene recovered from a Swiss grotto near Thayingen. One example of such a pictorial

chronicling of an important event has been repeatedly described, and aptly illustrates its practical application. When Cortez held his first interview with the emissaries of Montezuma, one of the attendants of Teuhtlile, the chief Aztec noble, was observed sketching the novel visitors, their peculiar costumes and arms, their horses and ships; and by such means a report of all that pertained to the strange invaders of his dominion was transmitted to the Aztec sovereign. The skill with which every object was delineated excited the admiration of the Spaniards. But however superior this may have been as a piece of art, it was manifestly no advance on the principle of Indian picture-writing; nor can we be in much doubt as to its style of execution, since Lord Kingsborough's elaborate work furnishes many facsimiles of nearly contemporary Mexican drawings. In the majority of these, the totemic symbols, and the representations of individuals by means of their animal or other cognomens, are abundantly apparent. The specific aim of the artist has to be kept in view. The figures are for the most part grotesque, from the necessity of giving predominance to the special feature in which the symbol is embodied. To the generation for which such were produced, the connection between the sign, and the person or thing signified, would be manifest; and as a mnemonic aid, supplemented by verbal descriptions of the trained official registrars, the record would be ample. But a brief interval suffices to render such abbreviated symbols obscure, if not wholly unintelligible; and within less than a century after the Conquest, de Alva could not find more than two surviving Mexicans, both very aged, who were able to interpret the native pictorial records. Nevertheless a system of picture-writing, originating among the rude forest tribes with the simple employment of the imitative faculty in the representation of familiar objects, with their associated ideas, had advanced on this continent to the very same stage from which, in ancient Egypt, the next step was taken, resulting in the evolution of a phonetic alphabet, and so of all that is implied in letters in the largest sense.

To this grand aim of ideography, or an equivalent of written speech, may, as it appears to me, be traced the earliest efforts at drawing and painting, reaching back to that strange dawn of intellectual vigour revealed to us in the graphic art of the men of Europe's Palæolithic Age. The same effort at written speech underlies all the manifestations of the artistic faculty, common alike to the semi-civilized and to the barbarous native races of this continent; and in the terms by which they express the graphic art in their various dialects, the common significance of drawing and writing is generally apparent. But the æsthetic faculty was thus stimulated into activity with results which tended to develop art in all its forms of carving, modelling, sculpture, and painting. An appreciation of colour, not merely for personal adornment, but in its artistic application—alike as a decorative art, and as the means whereby natural objects can be presented with vivid truthfulness to the eye,—is widely diffused; though the mastery of form by the modeller or sculptor long precedes that of chiaroscuro, or aërial perspective. Aboriginal painting is crude, consisting mainly of colour without tone or shading, even where the drawing is correct. But paints and dyes, both of mineral and vegetable origin, are largely in use by many Indian tribes. The Eskimo execute tasteful patterns on their skin robes in diverse colours; and the northern tribes both to the east and west of the Rocky mountains dye porcupine quills and grasses, and with them work ornamental patterns on their dresses and in basket work. The pottery of the Pueblo Indians is elaborately decorated in colours; and in various other ways, as in the colouring of their masks, and the painting of their

boats and houses, by the Indians of Oregon and British Columbia,—the native taste for colour is manifested. Mr. Hugh Martin, in a communication of an early date to the American Philosophical Society, gives an account of the principal dyes employed by the North American Indians.[1] The Shawnees obtained a vegetable red, which they called *hau-ta-the-caugh*, from the root of a marsh plant, and largely used it in dying wool, porcupine quills, and the white hair of deers' tails. From another root, the *Radix flava*, a bright yellow was obtained, by mixing which with the red an orange tint is made. But they also extracted a rich orange colour from the Poccon root. A fine vegetable blue is also easily procured, and this was transformed to green by means of a yellow liquor of the smooth hickory bark. Black, which is much in demand, was obtained both from the sumack and from the bark of the white walnut. All the colours thus far named are vegetable dyes, but mineral colours are in general use for painting, and especially for personal decoration, which is no doubt the primary idea associated in the Indian mind with the verb "to paint." The Lenapes, Dr. Brinton remarks, "obtained red, white and blue clays, which were in such extensive demand that the vicinity of those streams in Newcastle County, Delaware, which are now called White Clay Creek and Red Clay Creek, are widely known to the natives as *Walamink*, 'the place of paint.'"[2] The Shawnees applied the name *Alamonee-sepee*, "Paint Creek," to the stream which falls into the Scioto close to Chilicothe. The word *walamen*, signifying "to paint," is the Shawnee *alamon*, and the Abnaki *wramann*, the *r* being substituted for the *l*. Roger Williams, describing the New England Indians, speaks of "*wunnam*, their red painting, which they most delight in,—both the bark of the pine, as also a red earth." The word is derived from Narr. *wunne*, Del. *wulit*, Chip. *gwanatseh*: "beautiful, handsome, good, pretty," etc. "The Indian who had bedaubed his skin with red ochreous clay, was esteemed in full dress, and delightful to look upon. Hence the term *wulit*, 'fine, pretty,' came to be applied to the paint itself."[3]

A review of the terms of art in the diverse aboriginal vocabularies would furnish an interesting supplement to the general question of the manifestation of an artistic faculty, and the evidences of appreciation of art among savage races. But it is too comprehensive a theme to be dealt with as the mere supplement to a paper already exceeding reasonable limits. But I note, in closing, a few illustrations, which the languages of some Northern Indian tribes supply, of the ideas associated in the native mind with terms of art. The Algonkin languages generally have no distinctive words clearly discriminating between painting, drawing, and writing in the sense of ideography; though the inevitable tendency to invent or appropriate words, as equivalents expressive of any novel object or idea, is in operation in those, as in other languages. The Ojibways have no generic term for painting the body or face, but express it by some word connected with the specific colour in use. For example, the painting the face black, as is done to a youth on attaining puberty, is *muhkuhdaekawin*. This consists of *muh-kuh-da*, meaning "black," *eka*, the form which gives it the verbal significance, "he makes himself black," with the termination *win*, constituting the whole a noun. So *misquah*, "red," is the root of *misquah-ne-ga-zoo*, "he is painted red;" *misquah-ne-gah-da*, "it is painted red." *Oozahwah*, "yellow," gives *oo-zah-we-ne-gah-zoo*, "he is painted yellow;" with the corresponding terminal

[1] Trans. Amer. Phil. Soc., iii. 222.
[2] The Lenape and their Legends. p. 53.
[3] *Ibid*, pp. 60, 104.

change for the neuter. But the word *oozahnamahne*, from *oonah*, "the cheek," is also used for painting the face either red or yellow. *Quahnaiy*, or *gwanai*, the word for "beautiful," is applied to moral as well as physical beauty, *e.g.*, *gwanaienene* would be used of a fair, honourable dealing man, as well as of one who was handsome or good-looking. But such rhetorical tropes are common to many languages.

The Rev. Silas T. Rand, for upwards of thirty years a missionary among the Micmac Indians of Nova Scotia, thus writes to me: "The Micmac is rich in words relating to art, the making and ornamenting of garments, moccasins, snowshoes, etc., of weapons and implements for domestic use, making pottery and modelling in clay. For building and managing a canoe there are at least seventy-six words. They have words for carving on stone, and also on wood, for marking dressed skins with flower patterns, for carving flowers in stone, for scraping them on birch-bark dishes, for drawing a likeness, making models and patterns, and for working after them. When I was engaged in translating 'Exodus,' and largely dependent on my Indian teacher for the words to express all the parts of the Tabernacle, its coverings and furniture, mortices, tenons, hooks, fillets, loops, bars, pins, sockets, etc., I fully expected to be baffled. What was my surprise to find that there were words in the language by which to express all I needed. Boards, bars, bolts, pillars, poles, rings, everything was made, put together, and my 'pundit,' an excellent mechanic, when he returned next day to go on with our work, assured me that he had been dreaming about that 'wigwam' we had been erecting the previous day, and he was sure he could make such a one. He had the pattern in his head as clearly as Moses had it, after he had seen it up the mountain." In the Micmac, *aweekum* is "a drawing," lit. "I write it," "I draw it;" *essum*, "I colour it;" *elapskudaaga*, "I am carving," or "cutting stone;" *elapskudaam*, "I am carving it in stone;" *apsk*, which here denotes "stone," is only used in composition; *coondow* is the word for "stone;" *eloksowa*, "I am carving in wood;" *noojeweekuga*, "a painter," "drawer," "writer," lit. "a maker of marks;" *aweegasik*, "a picture," lit. "it is marked down." etc.

The Algonkin root *walam*, "red," is the term employed in the *Walum Olum*, or "Red Score of the Lenape," which was brought under the notice of the New York Historical Society, in 1848, by Mr. E. G. Squier, as "The Bark Record of the Lenni-Lenape." His narrative has been more than once reprinted; but the carefully edited version of this curious Indian ideograph, given by Dr. Brinton, in his "Lenape and their Legends," will supersede earlier and less accurate versions. The full translation with which the pictographic record of the *Walum Olum* is accompanied, abundantly suffices to prove that it may be most correctly described as a series of mnemonic signs employed for the purpose of keeping in memory a national chant, of a class very familiar to the students of primitive history. The ballad epics of the ancient Germans, and the still earlier lays of ancient Rome, the Abanic Duan, and others of the genealogical and historical poems of the Celtic nations, were all of this class; and analogous traditionary chants have been perpetuated among the Maoris of New Zealand. The system of pictography corresponds to that in use among the Ojibways and other Algonkin tribes, including the totems, or sign-names; but it falls far short of true picture-writing. Section IV records the conquest by the Lenape tribe, of the northern country, which they call "The Snake Land." Bald Eagle, Beautiful Head, White Owl, Keeping Guard, Snow Bird, and a succession of other chiefs are named, all of whom are more or less graphically indicated by their totems; but a para-

phrastic interpretation accompanies them setting forth ideas that have no pictorial representation. Then comes a horizontal line with ten oblique lines rising from it, and three cross-lines below, with the interpretation: "After the Seizer there were ten chiefs and there was much warfare south and north." Next follows another succession of chiefs, each symbolized with some associated idea. Thus a group of six small circles, arranged upright in two columns, is surmounted by a larger circle, with three oblique lines rising from the top. This is paraphrased: "After him, Corn-Breaker was chief, who brought about the planting of corn." It is not difficult to imagine in the drawing the conventional representation of an ear of corn; but the major idea can be no more than one suggested to the memory by association. In some instances the picture-writing is more manifest. A horizontal line surmounted by two *tepees*, or buffalo-skin tents, is "the buffalo land." In one group, a semicircle with radiating lines, placed on a straight line, is translated. "Let us go together to the east, to the sunrise." In another case, nearly the same symbol —assumed, no doubt, to represent the sun setting in the ocean,—is rendered, "at the great sea." It is, indeed, a system of picture-writing; but instead of being abbreviated into word-symbols, it is reduced to mere catch-words or mnemonic signs. Their value would be unquestionable as an aid to memory in the perpetuation of a mythic or historical poem; but, if the tradition were lost, they embody no record from which to recover it.

Neither the Iroquois nor the Algonkin nations can be pointed to as specially gifted with imitative powers, or in other ways furnishing evidence of any highly developed artistic faculty. They cannot compare in this respect with the Zuni, or others of the Pueblo Indians, among whom the arts of long-settled, agricultural communities have been developed for purposes of ornament as well as utility; nor is their inferiority less questionable when we compare them with some of the barbarous tribes of the Northwest coast, and the neighbouring islands. Their languages confirm this; for while, as Mr. Cushing has shown, the Zuni language possesses many words relating to art-processes, the Iroquois and Algonkin dialects supply such terms, for the most part, in descriptive holophrasms, and not in primitive roots. Nevertheless, alike in their pottery and carvings, and in their picture-writing, they show a degree of artistic capacity of which few traces are found in Europe's Neolithic Age.

In the Ojibway, *oozhebegawin*, is used indiscriminately for "writing, drawing, painting," *wazhebeegad*, for "a man who writes, draws." In combination with *muh-ze-ne*, "figure, form," such words are in use as *muhzenebeégawin*, "a painting, drawing;" *muhzenebeégawenene* (M), *muhzenebeégawequa* (F), "a painter, an artist;" *muhzenebeégun*, "a picture." "To carve," or "engrave on a rŏck," is *muhzeneko; muhzenekojegun*, "a sculptor's chisel;" *muhzenekoda*, "it is carved," etc. Again with *wahbegun*, "clay," such holophrasms are obtained as *wahbegunoonahgunekawenene*, "a man who makes earthern vessels, a potter," *wahbeguhega*, "a worker in clay," lit. "I work with clay,"

In Iroquois, the word *kar* or *kare* signifies "to paint" or "draw." The initial *k* in Iroquois words is usually not radical, and so rarely enters into composite terms. The root of *kar*, is *ar* or *are*, which added to *kaiata*, or *oiata*, "living thing, person, body," makes *kaiatare* "image" or "likeness," *i.e.* "pictured body;" or as a verb "to paint" or "depict anything." To this is added the verbal suffix *ta* or *tha*, which occasionally becomes *stha*, and has different meanings, causative and instrumental.

The Mohawk supplies such words and terms of art as *ahyeyatonh*, "to grave;"

rahyatonhs, "an engraver;" *ahyekonteke,* "to paint;" *rakonteks,* "a painter;" *s'hakoyatarha,* "an artist;" *rahkaratahkwas,* "a carver;" *rateanakerahtha,* "a modeller," or "one who models figures in clay." In the Iroquois version of the "Gospel of St. John," Chap. VIII. verse 6, reads thus: *Nok tanon ne Iesos wathastsake ehtake nok rasnonsake* (more correctly *rasnonkenh*) *warate wahiaton onwentsiake,* lit. "But instead Jesus bent low and with hand used, wrote," or "engraved, on the earth." The version of the second commandment in the Mohawk Prayer Book affords another illustration, in the holophrasm *asadatyaghdoenihseroenyea.* It is compounded of *ahsonniyon,* "make;" *ahsadadonnyen,* "to make for yourself;" *kayadonnihsera,* "an image" or "doll." *Toghsa asadatyaghdoenihseroenyea, shekonh othenouh taoesakyatayerea nene enekea karouhyakouh, neteas eghtake oughweatsyakonh,* etc., lit. "Do not make an image or idol for yourself, even anything like above in the sky, nor below in the earth," etc.

The word *kaiata,* or *oiata,* as already noted, signifies "a living thing, person," or "body;" *kakonsa* or *okonsa,* is the "face" or "visage;" and from those come many derivatives. Bruyas gives *gaiata,* "a living thing;" *gaiatare* (or *kaiatare*) "image," and as a verb, "to paint." There is also *gaiatonni,* "a doll" or "puppet," *i.e.* "a made person," from *oiata* and *konnis,* "to make." From the same root we may probably derive *kiaton,* "to write," as in the Iroquois gospels, *wahaiaton,* "wrote;" *kahiaton,* "it is written," etc. The original meaning was, no doubt, picture-writing, *i.e.* making images of things. In the old Onondaga dictionary of the Jesuit Fathers is the word *kiatonnion,* "I keep writing." The same authority also gives *guianatonh,* (*kianatonh*) "I paint," apparently from another root, *oiana* (*kaiana*) "track, walk, gait," etc., which has many derivatives. In previous remarks on the main subject of this paper, the development of the artistic faculty has been noted as, in many cases, an exceptional manifestation of intellectual activity, alike in ancient and modern barbarous races. The striking contrast between the richly fluent forms of the language, and the infantile condition of this people in relation to so much else, including metallurgy, and the application of the arts generally to the practical requirements of life, furnishes a no less interesting illustration of intellectual development fostered by special influences in another direction. The habitual practice of oratory made the Iroquois acute reasoners; and their language abounds in abstract terms to a degree altogether surprising in an uncivilized race. The purposes of the rhetorician also encouraged the tropical use of literal terms. It is not, therefore, difficult to understand how the primary sense of the verb "to track" or "trace out" should ultimately yield the meaning of "drawing" or "sketching," and so finally of "painting."

Kayadareh, or *kyadareh,* signifies "a body or form *in,*" *e.g.* "in a frame" or "group;" *kyadarastonh,* on the other hand, implies "a body" or "form transferred *on* to something," *e.g.,* a board or canvas. The latter is therefore the more expressive and correct term to use for drawing or painting, and is here given as an example of the Mohawk verb, "to draw." It affords some illustration of the power of the language to express, with grammatical nicety of detail, the requisite distinctive forms of variation, in relation to the practice of drawing or painting as an art.

THE VERB *Kyadarahste:* To Draw (a picture).

ACTIVE VOICE.

INDICATIVE MOOD.

Present Indefinite Tense.

1. Without Object.

	SING.
wakyadarahste	I draw.
washadarahste	Thou drawest.
wahayadarahste	He draws.
wakayadarahste	She draws.
	DUAL.
wedeniyadarahste	We two draw.
weseniyadarahste	You two draw.
wahniyadarahste	They two (M.) draw.
wakeniyadarahste	They two (F.) draw.
	PLUR.
wedewayadarahste	We draw.
wesewayadarahste	You draw.
wahadiyadarahste	They (M.) draw.
wakondiyadarahste	They (F.) draw.

2. With Masculine Object.

	SING.
wahiyadaraste	I draw him.
wahtsyadaraste	Thou drawest him.
wahoyadaraste	He *or* she draws him.
	DUAL.
wahtsideniyadaraste	We two draw him.
wahtsiseniyadaraste	You two draw him.
wahonwayadaraste	They two draw him.
	PLUR.
wahtsidewayadaraste	We draw him.
wahtsisewayadaraste	You draw him.
wahonwayadaraste	They draw him.

3. With Feminine Object.

	SING.
wahkheyadarahste	I draw her.
wahsheyadarahste	Thou drawest her.
wahshakoyadarahste	He draws her.
waakoyadarahste	She draws her.
	DUAL.
waethiyadarahste	We two draw her.
waetshiyadarahste	You two draw her.
wahshakodiyadarahste	They two (M.) draw her.
waakodiyadarahste	They two (F.) draw her.
	PLUR.
waethiyadarahste	We draw her.
waetshiyadarahste	You draw her.
wahshakodiyadarahste	They (M.) draw her.
waakodiyadarahste	They (F.) draw her.

4. With Feminine *or* Neuter Object.

	DUAL.
waakeniyadarahste	We two draw her *or* it.
weseniyadarahste	You two draw her *or* it.
wahniyadarahste	They two draw her *or* it.

Present Progressive Tense.

1. Without Object.

	SING.
kyadarahstha	I am drawing.
jadarahstha	Thou art drawing.
rayadarahstha	He is drawing.
kayadarahstha	She is drawing.
	DUAL.
deniyadarahstha	We two are drawing.
seniyadarahstha	You two are drawing.
niyadarahstha	They two (M.) are drawing.
keniyadarahstha	They two (F.) are drawing.
	PLUR.
dewayadarahstha	We are drawing.
sewayadarahstha	You are drawing.
radiyadarastaha	They (M.) are drawing.
kondiyadarahstha	They (F.) are drawing.

2. With Masculine Object.

	SING.
riyadarahstha	I am drawing him.
ehtsyadarahstha	Thou art drawing him.
royadarahstha	He *or* she is drawing him.
	DUAL.
ehtsideniyadarahstha	We two are drawing him.
ehtsiseniyadarahstha	You two are drawing him.
ronwayadarahstha	They two are drawing him.
	PLUR.
ehtsidewayadarahstha	We are drawing him.
ehtsisewayadarahstha	You are drawing him.
ronwayadarahstha	They are drawing him.

PRESENT PROGRESSIVE. (*Continued.*)

3. With Feminine Object.

SING.

k'heyadarahstha	I am drawing her.
s'heyadarahstha	Thou art drawing her.
s'hakoyadarahstha	He is drawing her.
yakoyadarahstha	She is drawing her.

DUAL.

deniyadarahstha	We two are drawing her.
seniyadarahstha	You two are drawing her.
konwadarahstha	They two are drawing her.

PLUR.

yethiyadarahstha	We are drawing her.
yetsiyadarahstha	You are drawing her.
s'hakodiyadarahstha	They (M.) are drawing her.
yakodiyadarahstha	They (F.) are drawing her.

4. With Feminine *or* Neuter Object.

SING.

kyadarahstha	I am drawing her *or* it.
jadarahstha	Thou art drawing her *or* it.
rayadarahstha	He is drawing her *or* it.
yoyadarahstha	She is drawing her *or* it.

PLUR.

dewayadarahstha	We are drawing her *or* it.
sewayadarahstha	You are drawing her *or* it.
konwayadarahstha	They are drawing her *or* it.

PRESENT PERFECT TENSE.[1]

1. With Masculine Object.

SING.

'neahriyadarahstonh	I have drawn him.
'neahehtsyadarahstonh	Thou hast drawn him.
'neahroyadarahstonh	He *or* she has drawn him.

DUAL.

'neahs'hakeniyadarahstonh	We two have drawn him.
'neahehtsiseniyadarahstonh	You two have drawn him.
'neahronwayadarahstonh	They two have drawn him.

PLUR.

'neahs'hakwayadarahstonh	We have drawn him.
'neahshtsisewayadarahstonh	You have drawn him.
'neahronwayadarahstonh	They have drawn him.

2. With Feminine Object.

SING.

'neahk'heyadarahstonh	I have drawn her.
'neahs'heyadarahstonh	Thou hast drawn her.
'neahs'hakoyadarahstonh	He has drawn her.
'neahyakoyadarahstonh	She has drawn her.

DUAL.

'neahyak'hiyadarahstonh	We two have drawn her.
'neahyotsiyadarahstonh	You two have drawn her.
'neahyontadyadarahstonh	They two have drawn her.

PLUR.

'neahyetheyadarahstonh	We have drawn her.
'neahyetsiyadarahstonh	You have drawn her.
'neahs'hakodiyadarahstonh	They (M.) have drawn her.
'neahyakodiyadarahstonh	They (F.) have drawn her.

3. With Feminine *or* Neuter Object.

SING.

'neahkyadarahstonh	I have drawn her *or* it.
'neahtsyadarahstonh	Thou hast drawn her *or* it.
'neahrayadarahstonh	He has drawn her *or* it.
'neahroyadarahstonh	She has drawn her *or* it.

DUAL.

'neahyakeniyadarahstonh	We two have drawn her *or* it.
'neahseniyadarahstonh	You two have drawn her *or* it.
'neahkonwayadarahstonh	They two have drawn her *or* it.

PLUR.

'neahdewayadarastonh	We have drawn her *or* it.
'neahsewayadarahstonh	You have drawn her *or* it.
'neahkonwayadarahstonh	They have drawn her *or* it.

[1] The Present Perfect *'neahriyadarahstonh* is here expressed by means of the prefix *'neah* (otherwise written *'nenh* or *'nunh*) a corruption of the word *oneah* or *onenh*, meaning "now." "I have drawn" or "pictured him," is in Mohawk *oneariyadarahstonh*; literally, "I have now drawn him." The apostrophe in *'neah* denotes the omission of the initial syllable of the word *oneah*, or *onenh*.

Kyadarahste: To Draw.

ACTIVE. (*Continued.*) INDICATIVE. (*Continued.*)

Present Perfect Progressive Tense.

1. With Masculine Object.

SING.

'neasehriyadarahstakwe	I have been drawing him.
'neasehehtsyadarahstakwe	Thou hast been drawing him.
'neasehroyadarahstakwe	He *or* she has been drawing him.

DUAL.

'neasehshakeniyadarahstakwe	We two have been drawing him.
'neasehehtsiseniyadarahstakwe	You two have been drawing him.
'neasehronwayadarahstakwe	They two have been drawing him.

PLUR.

'neasehs'hakwayadarahstakwe	We have been drawing him.
'neasehehtsisewayadarahstakwe	You have been drawing him.
'neasehronwayadarahstakwe	They have been drawing him.

2. With Feminine Object.

SING.

'neasehk'heyadarahsthakwe	I have been drawing her.
'neasehs'heyadarahsthakwe	Thou hast been drawing her.
'neasehs'hakoyadarahsthakwe	He has been drawing her.
'neasehyakoyadarahsthakwe	She has been drawing her.

DUAL.

'neasehyak'hiyadarahsthakwe	We two have been drawing her.
'neasehyetsiyadarahsthakwe	You two have been drawing her.
'neasehyakodiyadraahsthakwe	They two have been drawing her.

PLUR.

'neasehyakhiyadarahsthakwe	We have been drawing her.
'neasehyetsiyadarahsthakwe	You have been drawing her.
'neasehs'hakodiyadarahsthakwe	They (M.) have been drawing her.
'neasehyakodiyadarahsthakwe	They (F.) have been drawing her.

3. With Feminine *or* Neuter Object.

SING.

'neasehkyadarahsthakwe	I have been drawing her *or* it.
'neasehtsyadarahsthakwe	Thou hast been drawing her *or* it.
'neasehrayadarahsthakwe	He has been drawing her *or* it.
'neasehyoyadarahsthakwe	She has been drawing her *or* it.

DUAL.

'neasehyakeniyadarahsthakwe	We two have been drawing her *or* it.
'neasehseniyadarahsthakwe	You two have been drawing her *or* it.
'neasekeniyadarahsthakwe	They two have been drawing her *or* it.

PLUR.

'neasehyakwayadarahsthakwe	We have been drawing her *or* it.
'neasehsewayadarahsthakwe	You have been drawing her *or* it.
'neasekeniyadarahsthakwe	They have been drawing her *or* it.

Past Perfect Tense.

1. With Masculine Object.

SING.

'neashihiyadarahstonh	I had drawn him.
'neashitsyadarahstonh	Thou hadst drawn him.
'neashihoyadarahstonh	He *or* she had drawn him.

PLUR.

'neashishakwayadarahstonh	We had drawn him.
'neashitsisewayadarahstonh	You had drawn him.
'neashihonwayadarahstonh	They had drawn him.

DUAL.

'neashishakeniyadarahstonh	We two had drawn him.
'neashitsisenniyadarahstonh	You two had drawn him.
'neashihonwayadarahstonh	They two had drawn him.

PAST PERFECT. (*Continued.*)

2. With Feminine Object.

SING.

'neashikheyadarahstonh	I had drawn her.
'neashisheyadarahstonh	Thou hadst drawn her.
'neashishakoyadarahstonh	He had drawn her.
'neashiyokoyadarahstonh	She had drawn her.

DUAL.

'neashiyakhiyadarahstonh	We two had drawn her.
'neashiyetsiyadarahstonh	You two had drawn her.
'neashiyontadarahstonh	They two had drawn her.
'neashishakotiyadarahstonh	They two (M.) had drawn her.
'neashiyakotiyadarahstonh	They two (F.) had drawn her.

PLUR.

'neashiyakhiyadarahstonh	We had drawn her.
'neashiyetsiyadarahstonh	You had drawn her.
'neashiyontadyadarahstonh	They had drawn her.

3. With Feminine *or* Neuter Object.

SING.

'neashikyadarahstonh	I had drawn her *or* it.
'neashishadarahstonh	Thou hadst drawn her *or* it.
'neashihayadarhstonh	He had drawn her *or* it.
'neashiyoyadarahstonh	She had drawn her *or* it.

DUAL.

'neashiyakeniyadarahstonh	We two had drawn her *or* it.
'neashiseniyadarahstonh	You two had drawn her *or* it.
'neashikonwayadarahstonh	They two had drawn her *or* it.
'neashiniyadarahstonh	They two (M.) had drawn her *or it.*
'neashiyodiyadarahstonh	They two (F.) had drawn her *or* it.

PLUR.

'neashiyakwayadarahstonh	We had drawn her *or* it.
'neashisewayadarahstonh	You had drawn her *or* it.
'neashikonwayadarahstonh	They had drawn her *or* it.

PAST INDEFINITE TENSE.

1. With Masculine Object.

SING.

wahiyadarahste	I drew him.
watsyadarahste	Thou drewest him.
wahoyadarahste	He *or* she drew him.

DUAL.

wahtsideniyadarahste	We two drew him.
wahtsiseniyadarahste	You two drew him.
wahonwayadarahste	They two drew him.

PLUR.

was'hakwayadarahste	We drew him.
watsisewayadarahste	You drew him.
wahonwayadarahste	They drew him.

2. With Feminine Object.

SING.

wakyadarahste	I drew her.
washakoyadarahste	Thou drewest her.
waoyadarahste	He drew her.

DUAL.

wedeniyadarahste	We two drew her.
weseniyadarahste	You two drew her.
wakonwayadarahste	They two drew her.

PLUR.

waakwayadarahste	We drew her.
waetsiyadarahste	You drew her.
wahs'hakodiyadarahste	They (M.) drew her.
waakodiyadarahste	They (F.) drew her.

3. With Feminine *or* Neuter Object.

SING.

wakyadarahste	I drew her *or* it.
wahsheyadarahste	Thou drewest her *or* it.
wahayadarahste	He drew her *or* it.
waoyadarahste	She drew her *or* it.

PLUR.

waakwayadarahste	We drew her *or* it.
wesewayadarahste	You drew her *or* it.
wakonwayadarahste	They drew her *or* it.

PAST PROGRESSIVE TENSE.

1. With Masculine Object.

SING.

riyadarahstahkwe	I was drawing him.
ehtsyadarahsthakwe	Thou wast drawing him.
royadadarahsthakwe	He *or* she was drawing him.

DUAL.

s'hakeniyadarahsthakwe	We two were drawing him.
ehtsiseniyadarahsthakwe	You two were drawing him.
ronwayadarahsthakwe	They two were drawing him.

PLUR.

s'hakwayadarahsthakwe	We were drawing him.
ehtsisewayadarahsthakwe	You were drawing him.
ronwayadarahsthakwe	They were drawing him.

Kyadarahste : To Draw

ACTIVE. (*Continued.*) INDICATIVE. (*Continued.*)

PAST PROGRESSIVE. (*Continued.*)

2. With Feminine Object.

	SING.
k'heyadarahsthakwe	I was drawing her.
s'heyadarahsthakwe	Thou wast drawing her.
s'hakoyadarahsthakne	He was drawing her.
yakoyadarahsthakwe	She was drawing her.
	DUAL.
yak'hiyadarahsthakwe	We two were drawing her.
yetsiyadarhasthakwe	You two were drawing her.
s'hakodiyadarahsthakwe	They two were drawing her.
	PLUR.
yakhiyadarahsthakwe	We were drawing her.
yetsiyadarahsthakwe	You were drawing her.
shakodiyadarahsthakwe	They were drawing her.

3. With Feminine *or* Neuter Object.

	SING.
kyadarahsthakwe	I was drawing her *or* it.
tsyadarahsthakwe	Thou wast drawing her *or* it.
rayadarahsthakwe	He was drawing her *or* it.
yoyadarahsthakwe	She was drawing her *or* it.
	DUAL.
yakeniyadarahsthakwe	We two were drawing her *or* it.
seniyadarahshtakwe	You two were drawing her *or* it.
konwayadarahsthakwe	They two were drawing her *or* it.
	PLUR.
yakwayadarahsthakwe	We were drawing her *or* it.
sewayadarahsthakwe	You were drawing her *or* it.
konwayadarahsthakwe	They were drawing her *or* it.

PAST PERFECT PROGRESSIVE TENSE.

1. With Masculine Object.

	SING.
'neashihiyadarahsthakwe	I had been drawing him.
'neashihitsyadarahsthakwe	Thou hadst been drawing him.
'neashihoyadarahsthakwe	He *or* she had been drawing him.
	DUAL.
'neashihisakeniyadarahsthakwe	We two had been drawing him.
'neashihitsiseniyadarahsthakwe	You two had been drawing him.
'neashihihonwayadarahsthakwe	They two had been drawing him.
	PLUR.
'neashihis'hakwayadarahsthakwe	We had been drawing him.
'neashihitsisewayadarahsthakwe	You had been drawing him.
'neashihihonwayadarahsthakwe	They had been drawing him.

2. With Feminine Object.

	SING.
'neashihik'heyadarahsthakwe	I had been drawing her.
'neashihis'heyadarahsthakwe	Thou hadst been drawing her.
'neashihis'hakoyadarahsthakwe	He had been drawing her.
'neashihiyakoyadarahsthakwe	She had been drawing her.
	DUAL.
'neahs'hiyakhiyadarahsthakwe	We two had been drawing her.
'neashihiyetsiyadarahsthakwe	You two had been drawing her.
'neashihakodiyadarahsthakwe	They two had been drawing her.
	PLUR.
'neashihiyakhiyadarahsthakwe	We had been drawing her.
'neashihiyetsiyadarahsthakwe	You had been drawing her.
'neashihiyondadyadarahsthakwe	They had been drawing her.

3. With Feminine *or* Neuter Object.

	SING.
'neashihikyadarahsthakwe	I had been drawing her *or* it.
'neashihishadarahsthakwe	Thou hadst been drawing her *or* it.
'neashihihadiyadarahsthakwe	He had been drawing her *or* it.
'neashihiyoyadarahsthakwe	She had been drawing her *or* it.
	DUAL.
'neashihiyakenidarahsthakwe	We two had been drawing her *or* it.
'neashihiseniyadarahsthakwe	You two had been drawing her *or* it.
'neashikonwayadarahsthakwe	They two had been drawing her *or* it.
	PLUR.
'neashihiyakwayadarahsthakwe	We had been drawing her *or* it.
'neashihisewayadarahsthakwe	You had been drawing her *or* it.
'neashihkonwayadarahsthakwe	They had been drawing her *or* it.

FUTURE INDEFINITE TENSE.

1. With Masculine Object.

	SING.
cahiyadarahste	I shall draw him.
cahtsyadarahste	Thou shalt draw him.
cahoyadarahste	He *or* she shall draw him.
	DUAL.
cas'hakeniyadarahste	We two shall draw him.
catsiseniyadarahste	You two shall draw him.
cahonwayadarahste	They two shall draw him.
	PLUR.
cahtsidewayadarahste	We shall draw him.
cahtsisewayadarahste	You shall draw him.
cahonwayadarahste	They shall draw him.

2. With Feminine Object.

	SING.
cak'heyadarahste	I shall draw her.
cas'heyadarahste	Thou shalt draw her.
cas'hakoyadarahste	He shall draw her.
cayakoyadarahste	She shall draw her.
	DUAL.
cayakhiyadarahste	We two shall draw her.
cayetshiyadarahste	You two shall draw her.
cayontatyadarahste	They two shall draw her.
	PLUR.
cayakhiyadarahste	We shall draw her.
enyetsiyadarahste	You shall draw her.
cas'hakodiyadarahste	They (M.) shall draw her.
cayakodiyadarahste	They (F.) shall draw her.

3. With Feminine *or* Neuter Object.

	SING.
cakyadarahste	I shall draw her *or* it.
casyadarahste	Thou shalt draw her *or* it.
cahayadarahste	He shall draw her *or* it.
cayoyadarahste	She shall draw her *or* it.
	DUAL.
cayakeniyadarahste	We two shall draw her *or* it.
caseniyadarahste	You two shall draw her *or* it.
cakonwayadarahste	They two shall draw her *or* it.
	PLUR.
cayakwayadarahste	We shall draw her *or* it.
casewayadarahste	You shall draw her *or* it.
cakonwayadarahste	They shall draw her *or* it.

FUTURE PERFECT TENSE.

1. With Masculine Object.

	SING.
'neacahiyadarahstonh	I shall have drawn him.
'neacatsyadarahstonh	Thou shalt have drawn him.
'neacahoyadarahstonh	He *or* she shall have drawn him.
	DUAL.
'neacas'hakeniyadarahstonh	We two shall have drawn him.
'neacatsiseniyadarahstonh	You two shall have drawn him.
'neacahonwayadarahstonh	They two shall have drawn him.
	PLUR.
'neacas'hakwayadarahstonh	We shall have drawn him.
'neacatsisewayadarahstonh	You shall have drawn him.
'neacahonwayadarahstonh	They shall have drawn him.

2. With Feminine Object.

	SING.
'neacak'heyadarahstonh	I shall have drawn her.
'neacas'heyadarahstonh	Thou shalt have drawn her.
'neacas'hakoyadarahstonh	He shall have drawn her.
'neacayakoyadarahstonh	She shall have drawn her.
	DUAL.
'neacayakhiyadarahstonh	We two shall have drawn her.
'neacayetsiyadarahstonh	You two shall have drawn her.
'neacashakodiyadarahstonh	They two shall have drawn her.
	PLUR.
'neacayak'hiyadarahstonh	We shall have drawn her.
'neacayetsiyadarahstonh	You shall have drawn her.
'neacashakodiyadarahstonh	They shall have drawn her.

Kyadarahste : To Draw.

ACTIVE. (*Continued.*) INDICATIVE. (*Continued.*)

FUTURE PERFECT. (*Continued.*)

3. With Feminine *or* Neuter Object.

SING.

'neaeakyadarahstonh	I shall have drawn her *or* it.
'neaenshyadarahstonh	Thou shalt have drawn her *or* it.
'neaenhayadarahstonh	He shall have drawn her *or* it.
'neaeayoyadarahstonh	She shall have drawn her *or* it.

DUAL.

'neaeayakeniyadarahstonh	We two shall have drawn her *or* it.
'neaeaseniyadarahstonh	You two shall have drawn her *or* it.
'neaeahuiyadarahstonh	They two shall have drawn her *or* it.

PLUR.

'neaeadewayadarahstonh	We shall have drawn her *or* it.
'neaeasewayadarahstonh	You shall have drawn her *or* it.
'neaeakonwayadarahstonh	They shall have drawn her *or* it.

CONDITIONAL MOOD.[1]

PRESENT TENSE.

1. With Masculine Object.

SING.

ahiyadarahste	I should draw him.
ahtsyadarahste	Thou shouldst draw him.
ahoyadarahste	He *or* she should draw him.

DUAL.

ahtshideniyadarahste	We two should draw him.
ahtshiseniyadarahste	You two should draw him.
ahonwayadarahste	They two should draw him.

PLUR.

ahtshtewayadarahste	We should draw him.
ahtshisewayadarahste	You should draw him.
ahonwayadarahste	They should draw him.

2. With Feminine Object.

SING.

ak'heyadarahste	I should draw her.
as'heyadarahste	Thou should draw her.
as'hakoyadarahste	He should draw her.
ayakoyadarahste	She should draw her.

DUAL.

ayethiyadarahste	We two should draw her.
ayetsiyadarahste	You two should draw her.
as'hakodiyadarahste	They two should draw her.

PLUR.

ayethiyadarahste	We should draw her.
ayethieyadarahste	You should draw her.
as'hakodiyadarahste	They (M.) should draw her.
ayakodiyadarahste	They (F.) should draw her.

3. With Feminine *or* Neuter Object.

SING.

akyadarahsta	I should draw her *or* it.
ahshyadarahsta	Thou shouldst draw her *or* it.
ahayadarahsta	He should draw her *or* it.
ayoyadarahsta	She should draw her *or* it.

DUAL.

aedeniyadarahste	We two should draw her *or* it.
aeseniyadarahste	You two should draw her *or* it.
aaniyadarahste	They two should draw her *or* it.

PLUR.

aetewayadarahste	We should draw her *or* it.
aesewayadarahste	You should draw her *or* it.
akonwayadarahste	They (M.) should draw her *or* it.
akonwayadarahste	They (F.) should draw her *or* it.

[1] The Conditional Mood is sometimes rendered with the prefix *toka*, equivalent to the English "if." *Toka-ahiyadarahste*, "if I should draw him." But its equivalent may be assumed as implied in both.

Past Tense.

1. With Masculine Object.

SING.

ahiyadarahstonhse	I should have drawn him.
ahtsyadarahstonhse	Thou shouldst have drawn him.
ahoyadarahstonhse	He *or* she should have drawn him.

DUAL.

atshideniyadarahstonhse	We two should have drawn him.
atshitsiseniyadarahstonhse	You two should have drawn him.
ahonwayadarahstonhse	They two should have drawn him.

PLUR.

atshitsidwayadarahstonhse	We should have drawn him.
atsisewayadarahstonhse	You should have drawn him.
ahonwayadarahstonhse	They should have drawn him.

2. With Feminine Object.

SING.

ahk'heyadarahstonhse	I should have drawn her.
ahs'heyadarahstonhse	Thou shouldst have drawn her.
as'hakoyadarahstonhse	He should have drawn her.
ayakoyadarahstonhse	She should have drawn her.

DUAL.

ayethiyadarashtonhse	We two should have drawn her.
ayetshiyyadarahstonhse	You two should have drawn her.
ahs'hakodiyadarahstonhse	They two should have drawn her

PLUR.

ayetheyadarahstonhse	We should have drawn her.
ayetsiyadarahstonhse	You should have drawn her.
ahs'hakodiyadarahstonhse	They should have drawn her

3. With Feminine *or* Neuter Object.

SING.

akyadarahstonhse	I should have drawn her or it.
ahsyadarahstonhse	Thou shouldst have drawn her *or* it.
ahayadarahstonhse	He should have drawn her *or* it.
ayoyadarahstonhse	She should have drawn her *or* it.

DUAL.

acdeniyadarahstonhse	We two should have drawn her *or* it.
acseniyadarahstonhse	You two should have drawn her *or* it.
ahniyadarahstonhse	They two should have drawn her *or* it.

PLUR.

acdewayadarastonhseh	We should have drawn her *or* it.
acsewayadarastonhseh	You should have drawn her *or* it.
ahadiyadarahstonhse	They should have drawn her *or* it.

Past Progressive Tense.

1. With Masculine Object.

SING.

'neahs'hahiyadarahsthakwe	I should have been drawing him.
'neahs'hatsyadarahsthakwe	Thou shouldst have been drawing him.
'neahs'hahoyadarahsthakwe	He *or* she should have been drawing him.

DUAL.

'neahs'hatsideniyadarhasthakwe	We two should have been drawing him.
'neahs'hatsisenlyadarahshtakwe	You two should have been drawing him.
'neahs'hahonwayadarahsthakwe	They two should have been drawing him.

PLUR.

'neahs'hatsidewayadarahsthakwe	We should have been drawing him.
'neashatsisewayadarahsthakwe	You should have been drawing him.
'neashaonwayadarahsthakwe	They should have been drawing him.

2. With Feminine Object.

SING.

'neashakheyadarahsthakwe	I should have been drawing her.
'neahs'hayetshiyadarahsthakwe	Thou shouldst have been drawing her.
'neashayakoyadarahsthakwe	He should have been drawing her.

DUAL.

'neashayethiyadarahsthakwe	We two should have been drawing her.
'neahs'hayetshiyadarahsthakwe	You two should have been drawing her.
'neashashakodiyadarahsthakwe	They two should have been drawing her.

PLUR.

'neahs'hayethiyadarahsthakwe	We should have been drawing her.
'neahs'hayetsiyadarahsthakwe	You should have been drawing her.
'neahs'has'hakodiyadarahsthakwe	They (M.) should have been drawing her.
'neashayakodiyadarahsthakwe	They (F.) should have been drawing her.

Kyadarahste : To Draw.

ACTIVE. (*Continued.*) CONDITIONAL. (*Continued.*)

PAST PROGRESSIVE. (*Continued.*)

3. With Feminine *or* Neuter Object.

SING.

'neahs'hakyadarahsthakwe	I should have been drawing her *or* it.
'neahs'hashyadarahsthakwe	Thou shouldst have been drawing her *or* it.
'neahs'hahayadarahsthakwe	He should have been drawing her *or* it.
'neahs'hayoyadarahsthakwe	She should have been drawing her *or* it.

DUAL.

'neashaedeniyadarahsthakwe	We two should have been drawing her *or* it.
'neashaeseniyadarahsthakwe	You two should have been drawing her *or* it.
'neahshakonwayadarahsthakwe	They two should have been drawing her *or* it.

PLUR.

'neashaedewayadarahsthakwe	We should have been drawing her *or* it.
'neashaesewayadarahsthakwe	You should have been drawing her *or* it.
'neahshakonwayadarahsthakwe	They should have been drawing her *or* it.

IMPERATIVE MOOD.

SING.

ehtsyadarahst	Do thou draw him.
s'heyadarahst	Do thou draw her.
tsyadarahst	Do thou draw her *or* it.

DUAL.

iese deseniyahsea dakeniyadarast	Do ye two draw me.
iese deseniyahsea dakwayadarahst	Do ye two draw us.

PLUR.

ehtshiseniyadarahst	Do ye draw him.
yetshiyadarahst	Do ye draw her.
seniyadarahst	Do ye draw her *or* it.
dakwayadarahst	Do ye draw me.
dakeniyadarahst	Do ye draw us two.
yetsiyadarahst	Do ye draw them.

INFINITIVE.

kyadarahste To draw.

PARTICIPLES.

PRESENT ACTIVE.

kyadarahstha Drawing.

PAST.

kayadarahstonh Drawn.

PASSIVE VOICE.

INDICATIVE MOOD.

Present Indefinite Tense.

SING.

yonkyadarahstonh	I am drawn.
yesayadarahstonh	Thou art drawn.
ronwayadarahstonh	He is drawn.
konwayadarahstonh	She is drawn.

DUAL.

yonkhiyadarahstonh	We two are drawn.
yetsiyadarahstonh	You two are drawn.
ronwadiyadarahston	They two (M.) are drawn.
konwadiyadarahstonh	They two (F.) are drawn.

PLUR.

yonkhiyadarahstonh	We are drawn.
yetsiyadarahstonh	You are drawn.
ronwadiyadarahstonh	They (M.) are drawn.
konwadiyadarahstonh	They (F.) are drawn.

Present Progressive Tense.

SING.

yonkyadarahstha	I am being drawn.
yesayadarahstha	Thou art being drawn.
ronwayadarahstha	He is being drawn.
konwayadarahstha	She is being drawn.

PLUR.

yonkhiyadarahstha	We are being drawn.
yetshiyadarahstha	You are being drawn.
ronwadiyadarahstha	They (M.) are being drawn.
konwadiyadarahstha	They (F.) are being drawn.

Future Indefinite Tense.

SING.

cayonkyadarahste	I shall be drawn.
cayesayadarahste	Thou shalt be drawn.
cahonwayadarahste	He shall be drawn.
cakonwayadarahste	She shall be drawn.

DUAL.

cayonk'hiyadarahste	We two shall be drawn.
cayetsiyadarahste	You two shall be drawn.
cahonwadiyadarahste	They two (M.) shall be drawn.
cakonwadiyadarahste	They two (F.) shall be drawn.

PLUR.

cayonk'hiyadarahste	We shall be drawn.
cayetsiyadarahste	You shall be drawn.
cahonwadiyadarahste	They (M.) shall be drawn.
cakonwadiyadarahste	They (F.) shall be drawn.

Future Perfect Tense.

SING.

'neaeayonkyadarahstonh	I shall have been drawn.
'neacayesayadarahstonh	Thou shalt have been drawn.
'neacahonwayadarahstonh	He shall have been drawn.
'neacakonwayadarahstonh	She shall have been drawn

DUAL.

'neaeayonkhiyadarahstonh	We two shall have been drawn.
'neaeayetsiyadarahstonh	You two shall have been drawn.
'neaĕahonwadiyadarahstonh	They two shall have been drawn.

PLUR.

'neaeayonk'hiyadarahstonh	We shall have been drawn.
'neacayetsiyadarahstonh	You shall have been drawn.
'neaeahonwadiyadarahstonh	They (M.) shall have been drawn.
'neaeakonwadiyadarahstonh	They (F.) shall have been drawn.

Past Indefinite Tense.

SING.

yonkyadarahstonh	I was drawn.
yesayadarahstonh	Thou wast drawn.
ronwayadarahstonh	He was drawn.
konwayadarahstonh	She was drawn.

DUAL.

yonk'hiyadarahstonh	We two were drawn.
yetshiyadarahstonh	You two were drawn.
ronwadiyadarahstonh	They two (M.) were drawn.
konwadiyadarahstonh	They two (F.) were drawn.

PLUR.

yonkhiyadarahstonh	We were drawn.
yetshiyadarahstonh	You were drawn.
ronwadiyadarahstonh	They were drawn.

Kyadarashte : To Draw.

PASSIVE. (*Continued.*)

CONDITIONAL MOOD.

PRESENT TENSE.

	SING.
ayonkyadarahste-se	I should be drawn.
ayesayadarahste-se	Thou shouldst be drawn.
ahonwayadarahste-se	He should be drawn.
akonwayadarahste-se	She should be drawn.
	PLUR.
ayonkhiyadarahste-se	We should be drawn.
ayetsiyadarahste-se	You should be drawn.
aronwadiyadarahste-se	They (M.) should be drawn.
akonwadiyadarahste-se	They (F.) should be drawn.

PAST TENSE.

	SING.
ayonkyadarahstonh-se	I should have been drawn.
ayesayadarahstonh-se	Thou shouldst have been drawn.
ahonwayadarahstonh-se	He should have been drawn.
akonwayadarahstonh-se	She should have been drawn.
	PLUR.
ayonkhiyadarahstonh-se	We should have been drawn.
ayetsiyadarahstonh-se	You should have been drawn.
ahonwadiyadarahstonh-se	They (M.) should have been drawn.
akonwadiyadarahstonh-se	They (F.) should have been drawn.

The Iroquois tongue, in its various dialects, has long received the attention of diligent students. It has been written and printed both by French and English missionaries for nearly two centuries. As they have, for the most part, carried on their work without concert, there is no established system of orthography; but the language has been skilfully analyzed, and its elaborate grammatical structure systematized. The object of the above paradigm is simply to illustrate the inherent capacity of the language to express, with minute nicety of detail, the requirements of an æsthetic faculty as yet very partially developed. The latest results of philological study are amply set forth in the "Lexique" and the "Études philologique" of Abbé Cuoq, and in an admirable resumé in Mr. Horatio Hale's introduction to "The Iroquois Book of Rites."[1] The systematic processes by which the moods and tenses are indicated, either by changes of termination, or prefixed particles, or by both conjoined, are carefully indicated by Mr. Hale; but he adds: "a complete grammar of this speech, as full and minute as the best Sanscrit or Greek grammars, would probably equal, and perhaps surpass those grammars in extent. The unconscious forces of memory and of discrimination required to maintain this complicated intellectual machine, and to preserve it constantly exact, and in good working order, must be prodigious."[2] This tendency to elaborate niceties of discrimination is in striking contrast to that of the modern cultivated languages of Europe; and it is not without reason that it is spoken of as a "complicated intellectual machine." The contrast, for example, between the Mohawk or other Iroquois verb, in all its complex variations, and the extreme simplicity of the Anglo-Saxon verb, with only its Indefinite and Perfect Tenses,—the former predicated either of the present, or of a future time, and the latter of any past time,—can scarcely fail to impress the thoughtful student who keeps in view the relative civilization of the Iroquois, and of the English people at the period when Anglo-Saxon in its purely inflexional stage was still the national language. The English verb has since then acquired wonderful power and compass by means of the auxiliary verbs; but its whole tendency is at variance with the elaborations in number and gender

[1] Iroquois Book of Rites, p. 110.

[2] Iroquois Book of Rites, p. 112.

of the Iroquois verb. These are only partially illustrated in the above example, and might easily have been carried further. For example, the rendering of the Active, Indicative, Past Progressive, with Feminine Object, is really a verb in the passive voice. To realize the full inflexional niceties of such minute grammatical distinctions, the two genders should be given; and also a mixed gender, *i.e.* the two genders together, as the artists may consist of both sexes. This is indicated in the two forms of the Future Indefinite, by *eas'hakodiyadarahste*, "they (Mas.) shall draw her," *eayaktodiyadarahste*, "they (Fem.) shall draw her."

Both in the verb *Kyadarahste*, and in the other words applicable to art-processes, it is rather the aptitudes of the language, than its grammatical compass and complexities, that are illustrated. In the study of this, I have been largely indebted to Dr. Oronhyatekha and the Rev. Isaac Bearfoot, both educated Mohawks. Some of the terms of art given above are, no doubt, to be regarded as of modern origin, or coined words. Writing, engraving, modelling, etc., are not terms naturally to be looked for in the vocabulary of a people in the condition of the Iroquois when first brought under the notice of the French or English. But, as has been shown, drawing was already practised by them, and was applied by them to ideographic use. Hence their language furnished roots, as well as the formal processes, whereby to supply the necessary terms. *Ayehyatonh*, "to grave," is from *kahyatonh*, "a mark,"—*ayeh* giving the idea of the action. The word accordingly signifies "to make a mark," and is chiefly applied to writing. *Rahyatonhs*, "an engaver," is from the same root. The prefix *rah* not only shews the action, but marks the gender; literally, "he is making a mark." *Ayekonteke*, "to paint," is from *okontshera*, "paint," *a-ye* giving it the verbal significance. Another word, apparently modern, *yonhsohkwa*, is applied to dyes, and other colouring matter, as well as to paint. *Rakonteks*, "a painter," or "he paints," is also from the previous root, with the masculine prefix. *Shakoyadarha*, "an artist"—from *yeyadare*, "a picture of a person," *i.e.* of his body—signifies one who produces representations of people by any art. It suffices, therefore, to express "a portrait-painter, a sketcher of figures, a photographer," etc. *Shako* is the male prefix denoting action; for a female artist it becomes *yakoyadarha*, from *yakoya*, "a female." As for the words previously given for a carver and a modeller, they are, I believe, of modern origin, though fashioned from old forms of the language: *rahkaratahkwas*, "a carver," from *ohkara*, "chips," and *ratahkwas*, "he takes out;" *rateanakerahtha*, "a modeller," from *deweanakerahtonh*, "an imitation," *ratea*, expressive of the action in the masculine, from *ra*. It is not without abundant reason, as has been shown from the indications of an artistic faculty in aboriginal races, that the same terms are used to express the ideas of making a mark, drawing, or writing; and that an ideographic purpose appears to underly the earliest efforts at artistic imitation.

VII.—*Palæolithic Dexterity.*

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The discoveries of recent years in the department of prehistoric archæology have greatly extended our knowledge of the history of the human race; and have opened to us vistas through which we already look on many novel revelations such as, at no very distant period, it would have seemed presumptuous folly to imagine possible. We are as yet but on the threshold of such disclosures, and only imperfectly interpret the newly discovered chronicle. I propose now briefly to indicate a very subordinate, yet not wholly insignificant, glimpse at one attribute of man characteristic of him throughout the Historic Period; but on which some light appears to be thrown by the recovered knowledge concerning that strange epoch, when he was the contemporary of the mammoth, and of the long extinct carnivora of the caves, and the world of men was still in its childhood. Of the remoteness of the period thus appealed to there can, on any estimate of the age of man, be no room for doubt. It is abundantly demonstrated by the climatic changes affecting Europe in the interval since the fauna of southern France approximated to those of Lapland and Siberia, or to our own Hudson Bay Territory at the present time.

The assignment of the primitive relics of human art to a Stone Period, when the use of metals was unknown, and man had to furnish his implements and weapons solely from such accessible materials as wood, horn, bone, shell, stone, or flint, has naturally given a novel importance to this class of relics; and we owe to the pen of Dr. John Evans, not only an exhaustive review of the ancient stone implements, weapons, and ornaments of Great Britain, but also, incidentally, of the world's Stone Age, in nearly all countries and periods. In this work, accordingly, some of the earliest traces of man's handiwork, as the manipulator and tool-maker, are described. Of these, the implements of the River-drift Period are at once the rudest and most primitive in character. They occur in vast numbers, among the rolled gravel of the ancient fresh water, or river-drifts, which belong to what has received from the included implements the name of the *Palæolithic Period;* and if they are correctly assumed to represent the sole appliances of the man of the Drift Period, they indicate a singularly rude stage. In reality, however, the large, rude almond and tongue-shaped implements of flint are nearly imperishable; while trimmed flakes, small daggers or arrow-heads, and other delicately fashioned flint implements,—as well as any made of more perishable materials, such as shell, wood, or bone,—must have been fractured in the violence to which the rolled gravels were subjected, or would perish by natural decay.

It is not necessary, for the purpose of this paper, to discuss the relative age of the river-drift and cave implements. The most modern date assigned to them will amply suffice. The deposition of the implement-bearing river gravels, undoubtedly extended

over a very prolonged period, including that of the filling in of many of the caves with red-earth and gravel, embedding implements closely resembling those of the drift. The ossiferous deposits, moreover, found in some of the oldest caves of England, France, and Belgium, which have disclosed palæolithic tools, include also remains of the mammoth, cave-bear, fossil-horse, hyæna, reindeer, and other animals either wholly extinct, or such as prove by their character the enormous climatic changes referred to. In so far, therefore, as they afford any indication of the antiquity of man, they point to ages so remote that it is unnecessary to investigate the bearings of evidence suggestive of comparative degrees in time. Every new discovery does, indeed, add to our means of determining a relative prehistoric chronology which for some aspects of the inquiry is replete with interest and value. But I refer to the subject now, solely in its bearings on one very subordinate, yet significant, question relative to the manipulation of the primitive tool-makers.

The human hand is an organ so delicately fashioned that the biologist has, not unnaturally, turned to it in search of a typical structural significance. By reason of its mobility and its articulated structure, it is specially adapted to be an organ of touch; and the fine sense which education confers on it tends still further to widen the difference between the human hand, and that of the ape. But also, whether solely as a result of education, or traceable to some organic difference, the delicacy of the sense of touch, and the manipulative skill and mobility of the right hand, in the majority of cases, is found so far to exceed that of the left that a term borrowed from the former expresses the general idea of dexterity. That education has largely extended the preferential use of the right hand is undoubted. That it has even unduly tended to displace the left hand from the exercise of its manipulative function, I fully believe. But so far as appears, in the preference of one hand for the execution of many special operations, the choice seems, by general consent, without any concerted action, to have been that of the right. Not that there are not many left-handed workmen, artificers, and artists, often characterized by unusual skill and dexterity; but, the farther investigation is carried, the more apparent it becomes that such cases present exceptional deviations from what seems to be the normal usage of humanity. If the source of this characteristic preference is referable to any peculiarity in the structure of the hand, or of related organs, it ought to be easily explicable. Yet, thus far, after much patient observation and research, it is still an undetermined question. Differences between the right and left hand also manifest themselves in other ways. The right hand, for example, which is more sensitive to touch than the left, is affirmed to be less sensitive to temperature. Mr. George Henry Lewes, in his "Physiology of Common Life," says, "If the two hands be dipped in two basins of water at the same temperature, the left-hand will feel the greater sensation of warmth; nay, it will do this even where the thermometers show that the water in the left basin is really somewhat colder than in the right basin;" and he adds: "I suspect that with 'left-handed' persons the reverse would be found."[1] On the assumption that the former is a well established law, the latter seems a legitimate inference; but as will be seen from what follows, there is good reason for doubting that the statement rests on an adequate amount of evidence.

To determine the prevalence of this relative sensitiveness to heat of the right and left hand, the test ought to be applied to uncultured and savage, as well as to civilized

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[1] Physiology of Common Life, ii. 298.

man. The elements which tend to complicate the enquiry are very various. The left-handed man is nearly always ambidextrous, though with an instinctive preference for the left hand, in any operation requiring either special dexterity or unusual force. Hence his right hand, though less in use than that of the right-handed man, is in no such condition of habitual inertia as the other's left hand. Again, a large number give the preference to the right hand from a mere compliance with the practise of the majority; but with no special innate impulse to the use of one hand rather than the other. But besides these, there is a considerable minority in whom certain indications suffice to show that the bias, though no strong and over-ruling impulse, is in favour of the left hand. I have, accordingly, had a series of tentative observations made for me in the Physical Laboratory of University College, under the superintendence of Mr. W. J. Loudon, Demonstrator of Physics. The students of the college willingly submitted themselves to the requisite tests; and the series of experiments were carried out by Mr. Loudon with the utmost care. No idea was allowed to transpire calculated to suggest anticipated results. A highly characteristic Canadian test of any latent tendency to right or left-handedness was employed. In the use of the axe, so familiar to nearly every Canadian, alike in summer camping out, and in the preparation of winter fuel, the instinctive preference for one or other hand is shown in always keeping the surer hand nearest the axe-blade. This test was the one appealed to in classifying those who submitted to the following experiments. The trial was made with water very nearly 30° centigrade. The results arrived at are shewn here, the persons experimented on being divided into three classes: (1.) Right-handed, or those who habitually use the right hand, and who in handling an axe, place the right hand above the left, nearest the axe-head. (2.) Ordinarily using the right hand; but placing the left hand above the right in the use of the axe. These appear to be generally ambidextrous. (3.) Those who are generally said to be left-handed, but employ the pen in the right hand, and also use that hand in many other operations. This class includes very varying degrees of bias; and though loosely characterized as left-handed, from some greater or less tendency to use that hand, the majority of them were found to place the right hand above the left in the use of the axe. One hundred and sixty-four, in all, were subjected to the test, with the following results: Of ninety right-handed persons, thirty-five found the right hand the most sensitive, thirty-three the left hand, and twenty-two failed to discern an appreciable difference. Of fifty-six persons of the second class, right-handed, but using the left as the guiding hand with the axe, seventeen found the right hand the most sensitive, and fifteen the left, while twenty-four felt no difference. Of eighteen of the third class, six found the right hand the most sensitive, seven the left hand, and five could detect no difference. Another case was that of a lady, decidedly left-handed, who writes, sews, and apparently does nearly everything with her left hand. She tried at three temperatures, viz., 5°, 30°, and 48° centigrade. In the first case she pronounced the left hand to be undoubtedly colder, in the second she observed no difference, and in the third, the left hand was undoubtedly warmer. Another lady, also habitually using her needle in the left hand, and otherwise instinctively reverting to that hand in all operations requiring delicate or skilful manipulation, repeated the same experiment more than once, at my request; but could not detect any difference in the sensitiveness of either hand. The results thus stated were all arrived at with great care. It is manifest that they fail to confirm the statement set forth in the "Physiology

of Common Life," or to point to any uniformity in the relative sensitiveness of the right and left hands. In so far as either hand may prove to be more sensitive to heat than the other, it is probably due to the constant exertion of the one hand rendering it less sensitive to changes of temperature. Yet even this is doubtful. Two carpenters chanced to be at work in the College building while the above experiments were in progress. They were both right-handed workmen; yet, contrary to expectation, on being subjected to the test, they both pronounced the right hand to be most sensitive to heat. The statement of Mr. Lewes is so definite that the subject may be deserving of more extended experiment under other conditions. Any widely manifested difference in the sensitiveness of one of the hands, apart from its habitual use in all ordinary manipulation, and especially among uncultured races, would assuredly seem to indicate some congenital distinction leading to the preferential use of the right hand. But whatever may be the source of this preference, the difference between the two hands is not so great as to defy the influence of education; as is seen in the case of those who, even late in life, through any injury or loss of the right hand, are compelled to revert to the less dexterous one. It is, therefore, well worthy of the consideration of parents and teachers whether it would not be wise to encourage the habitual use of both hands; and in the case of manifest left-handedness, to content themselves with developing the free use of the right hand without suppressing the inate dexterity of the left. My own experience, as one originally left-handed, is that, in spite of very persistent efforts on the part of teachers to suppress all use of the left hand, I am now thoroughly ambidextrous, though still with the left as the more dexterous hand. I use the pen in the right hand, but the pencil in the left; so that, were either hand disabled, the other would be at once available for all needful operations. It was the sad misfortune of Carlyle, when he had reached the advanced age of seventy-five, to lose the use of the right hand. The period of life was all too late to turn with any hope of success to the unaccustomed and untrained left hand; and in his journal more than one entry refers to the irreparable loss. But one curious embodiment of the reflections suggested by this privation is thus recorded in his journal, upwards of a year after experience had familiarized him with all that the loss involved:—" Curious to consider the institution of the Right hand among universal mankind; probably the very oldest human institution that exists, indispensable to all human co-operation whatsoever. He that has seen three mowers, one of whom is left-handed, trying to work together, and how impossible it is, has witnessed the simplest form of an impossibility, which but for the distinction of a 'right hand,' would have pervaded all human things. Have often thought of all that—never saw it so clearly as this morning while out walking, unslept and dreary enough in the windy sunshine. How old? Old! I wonder if there is any people barbarous enough not to have this distinction of hands; no human Cosmos possible to be even begun without it. Oldest Hebrews, etc., writing from right to left, are as familiar with the world-old institution as we. Why that particular hand was chosen is a question not to be settled, not worth asking except as a kind of riddle; probably arose in fighting; most important to protect your heart and its adjacencies, and to carry the shield on that hand.[2]"

The idea of the shield-hand, left and passive, is old as Homer, and familiar to us on

[2] Froude's Thomas Carlyle, iv. 347.

the most archaic Greek vases. The right side was ἐπὶ δόρυ, the spear side, while the left was, ἐπ' ἀσπίδα, the shield side. The familiar application of the terms in this sense is seen in Xenophon's "Anabasis," IV. iii. 26, Καὶ παρήγγειλε τοῖς λοχαγοῖς κατ' ἐνωμοτίας ποιήσασθαι ἕκαστον τὸν ἑαυτοῦ λόχον, παρ' ἀσπίδας παραγαγόντας τὴν ἐνωμοτίαν ἐπὶ φάλαγγος, "He ordered to draw up his century in squads of twenty-five, and post them in line to the left." And again, "Anabasis," IV. iii. 20: Τοῖς δὲ παρ' ἑαυτῷ παρήγγειλεν . . . ἀναστρέψαντας ἐπὶ δόρυ, κ.τ.λ., "He ordered his own division, turning to the right," etc. Egyptian paintings are older than the earliest Greek vases, but they are less reliable; for in the symmetrical arrangements of hieroglyphic paintings the groups of figures are habitually reversed, right and left, looking toward a central line or point. Yet, there also evidence may be found confirming the same idea. But a quaint philosopher of the seventeenth century, the famous old Norwich physician, Sir Thomas Browne, reverts to the mystic fancies of the Talmud for guidance, and questions the dictum reaffirmed by the sage of Chelsea. "Whether," says the author of "Religio Medici," "Eve was framed out of the left side of Adam, I dispute not; because I stand not yet assured which is the right side of a man, or whether there be such a distinction in nature." But whether the distinction is natural or the result of habit, the use of the left hand appears to be everywhere exceptional. The terms "right," "dexterous," and all their equivalents, are associated with dignity or eulogy; while that of "left," alike in cultured and barbarous languages, expresses awkwardness, incapacity, defectiveness. The left is the inferior, the ignoble, the sinister, the unlucky side; until, at length, one of the most ignoble perversions of social nobility, a morganatic, or "left-handed" marriage, gives its sinister pledge to a degrading travesty of the marriage tie. Thus, imbedded in the roots of ancient languages, and the customs of civilized and barbarous nations, as well as in sacred and profane history it becomes a question of some interest, wherein lies the source of a distinction so universally recognized?

The disclosures of archæology, in its cooperation with geological research, have familiarized us with phases of primitive history, inconceivable until very recent years. The handiwork of the Drift Folk relegates to very modern centuries the earliest Egyptian or Greek painting; and if in their remains evidence of primeval dexterity can be found, it will be scarcely possible to evade the conclusion that, from the beginning, man was right-handed. The earliest of all evidences of human dexterity, alike in its technical, and its popular sense, may be looked for among the products of the palæolithic workers in flint. The Drift Folk, and the primitive Troglodytes, of Europe, have transmitted to us works of human industry and skill, in comparison with which the oldest historical monuments are of recent date. But the process of the ancient arrow-maker is no lost art. It has been found in use among many barbarous races: and is still practised by some of the Indian tribes of this continent, to whom the art has doubtless been transmitted through successive generations from remotest times. The modes of manufacture vary somewhat among different tribes: but they have been repeatedly witnessed and described by explorers who have watched the native arrow-maker at work; and his operations no longer present the difficulties which were long supposed to beset this "lost art" of prehistoric times. Among the rarer primitive implements are hammer-stones, oblong or rounded in shape, generally with cavities worked in two faces, so as to admit of their being conveniently held between the finger and thumb. Implements of this class have

been repeatedly recovered from the French caves; an interesting example occurred among the objects embedded in the red cave-earth of Kents's Hole, Devonshire; and others, of different periods, usually quartzite pebbles, or nodules of flint, have been found in many localities. Some of them were probably used in breaking the larger bones to extract the marrow; but the battered edges of others show their contact with harder material. Similar hammer-stones occur in the Danish peat-mosses, in the Swiss lake-dwellings, in sepulchral deposits, and among other remains of modern savage art. They vary also in size; and were, no doubt, applied to diverse purposes.

The mode of fashioning the large, tongue-shaped implements and rude stone hatchets, which are among the most characteristic drift implements, it can scarcely be doubted, was by blows of a stone or flint hammer; as was obviously the case with large flint or hornstone unfinished implements recovered by me from some of the numerous pits of the Flint Ridge, a siliceous deposit of the Carboniferous Age, which extends through the State of Ohio, from Newark to New Lexington.[1] At various points along the ridge, funnel-shaped pits occur, varying from four or five to fifteen feet deep; and similar traces of ancient mining may be seen in other localities, as at Leavenworth, about three hundred miles below Cincinnati, where the grey flint or chert abounds, of which large implements are chiefly made. The sloping sides of the pits are in many cases covered with the fractured flints, some of them partially shaped as if for manufacture. The work in the quarry was, no doubt, the mere rough fashioning of the flint by the tool-makers, with a view to facility of transport, in many cases, to distant localities. But the finer manipulation, by means of which the carefully-finished arrow-heads, knives, lances, hoes, drills, scrapers, etc., were manufactured, was reserved for leisurely and patient skill. Longfellow, in his Indian epic, represents the Dacotah Arrow-maker busy plying his craft. It was no doubt pursued by specially skilled workmen; for considerable dexterity is needed in striking the flakes from the flint core, and fashioning them into the nicely-finished edged tools and weapons to be seen in many museums. The choice of material is not limited to flint.

> " At the doorway of his wigwam
> Sat the ancient Arrow-maker,
> In the land of the Dacotahs,
> Making arrow-heads of jasper,
> Arrow-heads of chalcedony."

Beautifully finished arrow-heads and other smaller implements fashioned of jasper chalcedony, white quartz, and rock-crystal, are among the prized relics of many collections. The diversity of fracture in such materials must have taxed the skill of the expert workman, familiar chiefly with the regular cleavage of the obsidian, chert, or flint. But it is now known that the more delicate operations in the finishing of the flint implements were done by means of pressure with a horn or bone arrow-flaker; and not by a succession of blows with a chisel or hammer. The process has been repeatedly described by eye-witnesses. Dr. Evans quotes more than one account of methods pursued among the Eskimo, the native Mexicans, and the Shasta Indians of California. Another, and in some respects more minute account of the process, as it is in use by the Wintoon Indians, is furnished by Mr. B.

[1] See Prehistoric Man, 3rd Ed., i. 70, Figs. 5, 6 and 7.

B. Redding, in the *American Naturalist*, from his own personal observation. The material, as among the Shasta Indians, was obsidian; but the process is equally applicable to flint, the cleavage of which is nearly similar.

The artificer was Consolulu, the aged chief of the Wintoon Indians. His implements consisted of a deer-horn prong split lengthwise, four inches long, and half an inch thick, with the semicircular ends at right angles; two deer-horn prongs, one smaller than the other, with the ends ground down nearly to the shape of a square sharp-pointed file; and a piece of well-tanned buckskin, thick, soft, and pliable. Laying, as we are told, a lump of obsidian, about a pound in weight, in the palm of the left hand, he placed between the first and second fingers of the same hand, the semi-cylindrical deer-horn implement so that the straight side of one of the ends rested about a quarter of an inch from the edge of the block of obsidian. With a small waterworn stone in his right hand, he struck the other end of the prong, and a flake of obsidian was severed well adapted for the arrow-head. On the buckskin, in the palm of his left hand, he laid the obsidian flake, which he held in place by the first three fingers of that hand, and then took such a position on the ground that the left elbow could rest on the left knee and obtain a firm support. Holding in his right hand the larger of the two pointed prongs, and resting his thumb on the side of his left hand to serve as a fulcrum, he brought the point of the prong about one eighth of an inch within the edge of the flake; and then, exerting a firm downward pressure, fragment after fragment was broken off until the edge of the arrow was made straight. As all the chips came off the lower edge, the cutting edge was not yet in the centre of the side. But the Wintoon arrow-maker rubbed the side of the prong repeatedly over the sharp edge, turned over the flake, and, resuming the chipping as before, brought the cutting edge to the centre. In a similar manner, the other side and the concave base of the arrow-head were finished. The formation of indentations in the sides near the base for the retention of the tendons to bind the arrow-head securely to the shaft, apparently the most difficult process, was in reality the easiest. The point of the arrow-head was held between the thumb and finger of the left hand, while the base rested on the buckskin cushion in the palm. The point of the smaller deerhorn prong, not exceeding one sixteenth of an inch square, was brought to bear on the part of the side where the Indian arrow-maker considered the notch should be. A sawing motion made the chips fly to right and left, and in less than a minute it was cut to the necessary depth. The other side was then completed in like manner. The entire process was accomplished, and the arrow-head finished, in about forty minutes.

This account of the process of the Wintoon arrow-maker refers, it will be seen, with a marked though probably undesigned emphasis, to the use of the right hand in all his active manipulations. Its minute details are in other respects full of interest from the light we may assume them to throw on the method pursued by the primitive implement makers of the earliest Stone Age. Dr. Evans describes and figures a class of flint tools recovered from time to time, the edges of which, blunted and worn at both ends, suggest to his experienced eye their probable use for chipping out arrow-heads and other small implements of flint, somewhat in the fashion detailed above, with the tool of deer's horn. To those accordingly he applies the name of flaking tools, or fabricators. But whether fashioned by means of flint or horn fabricator, it is to be noted that the material to be operated upon has to be held in one hand, while the tool is dexterously mani-

pulated with the other. Signor Craveri, whose long residence in Mexico gave him very favourable opportunities for observing the process of the native workers in obsidian, remarks that, when the Indians "wish to make an arrow or other instrument of a splinter of obsidian, they take the piece in the left hand, and hold grasped in the other a small goat's horn. They set this piece of obsidian upon the horn, and dexterously pressing it against the point of it, while they give the horn a gentle movement from right to left, and up and down, they disengage from it frequent chips; and in this way obtain the desired form."[1] Again, in an account communicated to Sir Charles Lyell by Mr. Cabot, of the mode of procedure of the Shasta Indian arrow-makers, after describing the detachment of a piece from the obsidian pebble with the help of an agate chisel, he thus proceeds: "Holding the piece against the anvil with thumb and finger of his left hand, he commenced a series of blows, every one of which chipped off fragments of the brittle substance." The patient artificer worked upwards of an hour before he succeeded in producing a perfect arrow-head. His ingenious skill excited the admiration of the spectator, who adds the statement that, among the Indians of California, arrow-making is a distinct profession, in which few attain excellence.

The point noticeable here in reference to the accounts given by the various observers, is the uniform assumption of right-handedness. Mr. Redding, Signor Craveri, and Mr. Cabot, not only agree in describing the block of obsidian as held in the left hand, while the tools are employed in the right hand to fashion it into shape; but the whole language, especially in the description given by Signor Craveri, assumes right-handedness as, not only the normal, but the invariable characteristic of the worker in stone. In reality, however, an ingenious investigator, Mr. F. H. Cushing of the Smithsonian Institution, while engaged in a series of tentative experiments to determine the process of working in flint and obsidian, had his attention accidentally called to the fact that the primitive implements of the Stone Age perpetuate for us a record of the use of one or the other hand in their manufacture. With the instinctive zeal of youthful enthusiasm, Mr. Cushing, while still a boy, on his father's farm in Western New York, carried out a systematic series of flint workings with a view to ascertain for himself the process by which the ancient arrow-makers fashioned the flint implements that then excited his interest. After repeated failures in his attempts to chip the flint into the desired shape by striking off fragments with a stone hammer, he accidentally discovered that small flakes could be detached from the flint core with great certainty and precision by pressure with a pointed rod of bone or horn; and, as I have recently learned from him, the instrument employed by him in those experiments was the same as that which Dr. John Evans informs me he accidentally hit upon in his earliest successful efforts at flint-arrow making, viz., a tooth-brush handle. In thus employing a bone or horn flaker, the sharp edge of the flake cuts slightly into the bone; and when the latter is twisted suddenly upward, a small scale flies off at the point of pressure in a direction which can be foreseen and controlled. With this discovery the essential process of arrow-making had been mastered. Spear and arrow-heads could be flaked with the most delicate precision, with no such liability to fracture as leads to constant failure in any attempt to chip even the larger and ruder spear or axe-heads into shape. The hammer-stone only suffices for the earlier pro-

[1] Translated from Gastaldi. See Evans' Stone Implements, p. 36.

cesses, including the detachment of the flake from the rough flint nodule, and trimming it roughly into the required form, preparatory to the delicate manipulation of edging, pointing, and notching the arrow-head. The thinning of the flint-blade is effected by detaching long thin scales or flakes from the surface by using the flaker like a chisel and striking it a succession of blows with a hammer-stone. The marks of this delicate surface-flaking are abundantly manifest on the highly-finished Danish knives, daggers, and large spear-heads, as well as upon most other flint implements of Europe's Neolithic Age. The large spear and tongue-shaped implements of the drift are, on the contrary, rudely chipped, evidently by the blows of a hammer-stone; although some of the more delicately fashioned drift implements seem to indicate that the use of the flint or bone flaker was not unknown to the men of the Palæolithic Age. But the chipping-stone or hammer was in constant use at the later period; and the small hammer-stone, with indentations on its sides for the finger and thumb, and its rounded edges marked with the evidence of long use in chiping the flint nodules into the desired forms, abounds both in Europe and America, wherever the arrow-maker has carried on his primitive art. The implements in use varied with the available material. A T-shaped wooden flaker sufficed for the Aztecs in shaping the easily worked obsidian. The jasper, chalcedony, and quartz, in like manner, yields readily to the pressure of a slender flaker of horn; whereas Mr. Cushing notes that the "tough horn-stone of Western Arctic America could not be flaked by pressure in the hand, but must be rested against some solid substance, and flaked by means of an instrument, the handle of which fitted the palm like that of an umbrella, enabling the operator to exert a pressure against the substance to be chipped nearly equal to the weight of the body." One result of Mr. Cushing's experiments in arrow-making was to satisfy him that the greatest difficulty was to make long narrow surface-flakes. Hence, contrary to all preconceived ideas, it is easier to form the much-prized delicately-finished small arrow-head, with barbs and stem, than larger and seemingly ruder implements which involve much surface-flaking.

It is interesting to learn of the recovery of this lost art of the ancient arrow-makers by a series of tentative experiments independently pursued by different observers. Before Mr. Cushing's attention had been directed to any of the descriptions of the process of modern flint-workers, now familiar to us, he aimed at placing himself in the same conditions as the primitive manufacturer of Europe's Stone Age, or of the ancient Mound Builders of this Continent, devoid of metallic tools, and with the flint, obsidian, jasper, or hornstone, as the most available material out of which to fashion nearly all needful implements. He set to work accordingly with no other appliances than such sticks, and variously shaped stones, as could be found on the banks of the streams where he sought his materials. The results realize to us, in a highly interesting way, the earliest stages in the training of the self-taught workman of the Palæolithic Age. After making various implements akin to the most rudely fashioned examples from the river-drift or the old flint pits, by means of chipping one flint or stone with another, he satisfied himself that no amount of chipping, however carefully practised, would produce surfaces like the best of those which he was trying to imitate. He accordingly assumed that there must be some other process unknown to him. By chance he tried pressure with the point of a stick, instead of chipping with a stone, and the mystery was solved. He had hit on nearly the same method already described as in use by Aztecs, Eskimos and

Red Indians; and found that he could fashion the fractured flint or obsidian into nearly any shape that he desired. As has been already noted, like Mr. Cushing, and Dr. Evans, resorted subsequently to the easily available tool furnished by the handle of a tooth-brush. Having thus mastered the secret of the old flint-workers, he had succeeded before long in the manufacture of arrows, spear-heads, and daggers of flint, closely resembling the products of primitive workmen both of the Old and the New World.

Thus far the results accord with other investigations; but, in the course of his operations, Mr. Cushing also noted this fact that the grooves produced by the flaking of the flint, or obsidian, all turned in one direction. This proved to be due to the constant use of his right hand. When the direction of pressure by the bone or stick was reversed, the result was apparent in the opposite direction of the grooves. So far as his observations then extended, he occasionally found an arrow-head or other primitive stone implement with the flake grooves running from left to right, showing, as he believed, the manipulation of a left-handed workman; but, from the rarity of their occurrence, it might be concluded that, as a rule, prehistoric man was right-handed. When Mr. Cushing reported the results of those investigations into the arts of the Stone Age, at a meeting of the Anthropological Society of Washington, in May, 1879, Professor Mason confirmed from his own observation the occurrence of flint implements indicating by the reversed direction of the bevelling that they were produced by left-handed workmen. Mr. Cushing further notes that "arrow-making is accompanied by great fatigue and profuse perspiration. It has a prostrating effect upon the nervous system, which shows itself again in the direction of fracture. The first fruits of the workman's labour, while still fresh and vigorous, can be distinguished from the implements produced after he had become exhausted at his task; and it is thus noteworthy that on an unimpressible substance like flint even the moods and passions of long-forgotten centuries may be found thus traced and recorded."

In an ingenious brochure by Mr. Charles Reade, styled "The Coming Man," specially aiming at the development, in the rising generation, of the use of the left hand, so that the man of the future shall be ambidextrous, or "either-handed," he remarks: "There certainly is, amongst mankind, a vast weight of opinion against my position that man is, by nature, as either-handed as an ape; and that custom should follow nature. The majority believe the left arm and hand inferior to the right in three things,—power, dexterity, and dignity. Nor is this notion either old-fashioned or new-fangled. It is many thousand years old; and comes down, by unbroken descent, to the present day." The writer then goes on to affirm: "It has never existed amongst rank barbarians; it is not indicated in the genuine flint instruments; but only in those which modern dexterity plants in old strata, to delight and defraud antiquarians; and the few primitive barbarians that now remain, living relics of the Stone Age, use both arms indifferently."[1] The conclusions here assumed as established by evidence derived from the study of "the genuine flint instruments," imply, I presume, that they do embody indications of right and left hand manipulation in nearly equal proportions; whereas the forgeries of the modern "Flint Jack" all betray evidence of right-handed manufacture, and of consequent modernness. This, however, must have been set forth as a mere surmise; for, as now appears, it is in conflict with the results of careful investigations directed to the products of the

[1] The Coming Man, p. 12.

primitive flint workers. The opinion adopted by Mr. Cushing, after repeated observation and tentative experiment, is that primitive man was, as a rule, right-handed. The evidence adduced is insufficient for an absolute determination of the question; but any strongly-marked examples of the left-handed workman's art thus far observed among palæolithic flint implements appear to be exceptional. No higher authority than Dr. John Evans can be appealed to in reference to the manipulations of the primitive flint-worker, and, in writing to me on the subject, he remarks: "I think that there is some evidence of the flint-workers of old having been right-handed; the particular twist, both in some palæolithic implements, as in one in my own possession from Hoxne, and in some American rifled arrow-heads, being due to the manner of chipping, and being most in accordance with their being held in the left hand and chipped with the right." In the detailed description, given in his "Ancient Stone Implements of Great Britain," of the example from Hoxne, above referred to, Dr. John Evans remarks: "It presents the peculiarity, which is by no means uncommon in ovate implements, of having the side edges not in one plane, but forming a sort of ogee curve. In this instance the blade is twisted to such an extent, that a line drawn through the two edges near the point is at an angle of at least 45° to a line through the edges at the broadest part of the implement. I think," he adds, "that this twisting of the edges was not in this case intended to serve any particular purpose, but was rather the accidental result of the method pursued in chipping the flint into its present form."[1] A similar curvature is seen in a long-pointed implement from Reculver, in the collection of Mr. J. Brent, F.S.A., and again in another large example of this class, from Hoxne in Suffolk, presented to the Society of Antiquaries of London upwards of eighty years ago. This, as Dr. Evans notes, exhibits the same peculiarity of the twisting of the edges so markedly, and indeed so closely resembles the specimen in his own collection, that they might have been made by the same hand. Of another example, from Santon Downham, near Hetford, Suffolk, almond-shaped, and with dendritic markings in evidence of its palæolithic date, Dr. Evans remarks: "It is fairly symmetrical in contour, with an edge all round, which is somewhat blunted at the base. This edge, however, is not in one plane, but considerably curved, so that when seen sideways it forms an ogee curve;" and he adds: "I have other implements of the same, and of more pointed forms, with similarly curved edges, both from France, and other parts of England, but whether this curvature was intentional it is impossible to say. In some cases it is so marked that it can hardly be the result of accident; and the curve is, so far as I have observed, almost without exception Ƨ, and not S. If not intentional, the form may be the result of all the blows by which the implement was finally chipped out having been given on the one face on one side, and on the opposite on the other."[2] In other words, the implement-maker worked throughout with the flaker in the same hand; and that hand, with very rare exceptions, appears to have been the right hand. The evidence thus far adduced manifestly points to the predominance of right-handed men among the palæolithic flint-workers. For if the flint-arrow maker, working apart, and with no motive, therefore, suggested by the necessity of accommodating himself to a neighbouring workman, has habitually used the right hand from remote palæolithic times, it only remains to determine the origin of a practice too nearly invari-

[1] Ancient Stone Implements, p. 520.

[2] Ancient Stone Implements, p. 501.

able to have been the result of accident. This, however, appears to elude research; or thus far, at least, has been ascribed to very different causes. But to any who may still regard it as worthy of further consideration, the special class of implements referred to offers a trustworthy source of evidence, whereby to arrive at a relative estimate of the prevalent use of one or the other hand among uncultured races of men, alike, in ancient and modern times.

It is desirable that trustworthy statistics shall be collected; but this can only be done effectually by the co-operation of many observers. Very different opinions have thus far found expression as to the relative proportion of left and right-handed men; and in attempting any approximate determination of it, the civilized and cultured classes, affected by education, social habits, and many artificial usages, must be discriminated from those in whom nature has been left to operate with little constraint. Professor Hyrtl of Vienna assigns two per cent. as the ascertained proportion of left-handed persons; and this deduction, based on observations made in one of the most civilized centres of modern Europe, closely approximates to the oldest statistics of left-handedness, as recorded in the Book of Judges. But they differ widely from other results, derived under special circumstances from careful observation; as in some made by myself, on the loaders of barges on the Mississippi, where from fifteen to twenty per cent. seemed to use the left hand. In this case the subjects of observation represented the very rudest class of unskilled workmen, where neither culture nor any special necessity for combined operation had tended to develop a preference of one hand rather than another; and where no nicety of manipulation was required. Among the earliest notices of skill displayed in the preferential use of the left hand, that of the Benjamites, referred to in the Book of Judges, is specially noteworthy. Among the tribe of Benjamin left-handedness, if not more prevalent than in others of the Hebrew tribes, appears to have attracted greater notice. Ehud, the son of Gera, the deliverer of his people from the servitude of Ezlon, King of Moab, was a Benjamite, a left-handed man: and so, as he snatched from his right side the dagger with which he slew the Moabitish king, the motion of his left hand would not excite suspicion But the entire number of left-handed warriors of the tribe appears to have barely. amounted to 2.7 per cent. Out of twenty-six thousand Benjamites, as we are told, all warriors, there were seven hundred chosen men of the tribe, every one of whom was left-handed, and could sling stones at a hair's-breadth and not miss. The instinctively left-handed is ever dexterous in the true sense of that term. He is not only an exception to many right-handed men; he is still more an exception to the large majority in whom the bias is so slight and the dexterity so partial, that their practise is little more than a compliance with the usage of the majority.

Dr. Evans has figured and described what he believes to have been the flaking tools, or fabricators, in earliest use among the flint workers for chipping out arrow-heads and other small implements. They are fashioned of the same material; and some of them are carefully wrought into a form best adapted for being held in the hand of the workman. Specimens of the bone arrow-flakers in use by the Eskimo workers in flint are also familiar to us. Different forms of those instruments are engraved among the illustrations to "The Ancient Stone Implements, Weapons, and Ornaments of Great Britain," from specimens in the Blackmore Museum and the Christy Collection;[1] and Dr. Evans

[1] Evans' Stone Implements, Figs. 8, 9, 10.

describes the mode of using them as witnessed by Sir Edward Belcher among the Eskimo of Cape Lisburne, but without reference to the point now alluded to. Dr. John Rae, who, like myself, is inveterately left-handed, informs me that, without having taken particular notice of Indian or Eskimo practise in the use of one or the other hand, he observed that some among them were markedly ambi-dextrous. But, he adds, "from a curious story told me by an Eskimo about a bear throwing a large piece of ice at the head of a walrus; and telling me, as a noteworthy fact, that he threw it with the left forepaw, as if it were something unusual, it would seem to indicate that left-handedness was not very common among the Eskimos." But if the deductions based on the experimental working in flint are well founded, the test supplied by the direction of the flaking grooves of obsidian, chert, or flint implements, will be equally available for determining the prevalent use of one or other hand by the Eskimo and other modern savage races, as among those of the Palæolithic and Neolithic Periods.

I have already referred in a former paper, (*Canadian Journal*, N.S., Vol. XIII. p. 208) to an interesting discovery, supposed to indicate the traces of a left-handed workman of prehistoric times. The Rev. William Greenwell carried out a series of explorations of a number of flint-pits, known as Grimes' Graves, near Brandon, in Norfolk; and in a communication to the Ethnological Society of London on the subject, he states that in clearing out one of the subterranean galleries excavated in the chalk by the British workmen of the remote Neolithic Age, in order to procure flint nodules in a condition best adapted for their purpose, it was found that, while the pits were still being worked, the roof of the gallery had given way and blocked up its whole width. The removal of this obstruction disclosed three recesses extending beyond the face of the chalk, at the end of the gallery, which had been excavated by the ancient miners in procuring the flint. In front of two of these recesses thus hollowed out, lay two picks corresponding to others found in various parts of the shafts and galleries, made from the antlers of the red deer. But, Canon Greenwell noted that, while the handle of each was laid towards the mouth of the gallery, the tines which formed the blades of the picks pointed towards each other, shewing, as he conceived, that in all probability, they had been used respectively by a right and a left-handed man. The day's work over, the men had laid down their tools, ready for the next day's work; meanwhile the roof had fallen in, and the picks were left there undisturbed through all the intervening centuries, till the reopening of the gallery in recent years.

But the art of the palæolithic artificer was by no means limited to his operations in flint and stone. Specimens of his carvings in bone and ivory have been preserved, securely sealed up in the cave-breccia: his lances and daggers of deers' horn, his maces and batons decorated with artistic skill,—all furnishing assured tests of his dexterity. Still more, those relics of primitive art are accompanied by other evidences of æsthetic taste, serving to throw light on the question of the prevalence of right or left-handedness among the skilled workmen of Palæolithic or Neolithic Ages; as well as on the far more important question of the intellectual development of primitive man. Within the last twenty years repeated discoveries in ancient cave-dwellings and retreats of Europe, and especially in those of southern France, have familiarised us with numerous specimens of the work of skilled draftsmen of palæolithic Europe. The evidence which they furnish of the dexterity

of the ancient cave-men, in the more comprehensive sense of that term, is universally recognized; but my attention was first directed to the possible clue which they might furnish to the prevalent use of one or other hand in that remote age, by what, on further investigation, proved to be an error in the reproduction of the famous drawing of the Mammoth on a plate of its own ivory, found in La Madelaine Cave, in the Valley of the Vézère. In M. Louis Figuier's "L'Homme Primitif," for example, which might be assumed as a reliable authority in reference to the illustrative examples of French palæolithic art, the La Madelaine Cave sketch is incorrectly reproduced as a left-hand drawing; that is to say the mammoth is looking to the right. This is a nearly unerring test of right or left-handedness. The skilled artist can, no doubt, execute a right or left profile at his will. But an unpremeditated profile-drawing, if done by a right-handed draftsman, will be represented looking to the left; as, if it is the work of a left-handed draftsman, it will certainly look to the right.

The drawings of the ancient cave-men of Europe have naturally attracted much attention. They are referrable, beyond all dispute, to a period of long duration, when the mammoth and woolly rhinoceros, the fossil horse, the Irish elk, the cave bear, cave lion, and cave hyæna, with other extinct fauna, were to be found immediately to the north of the Pyrenees, along with the musk-sheep, the reindeer, and other Arctic mammals. The evidence, of the great antiquity and long duration of the period marked by this extinct fauna, is of so comprehensive a character that it may be assumed to have now received universal acceptance. Any indications, therefore, of special intellectual capacity, such as the carvings and drawings of the palæolithic cave-men reveal, are of special significance.

Those examples of primitive art are of varying degrees of merit. Some may be compared with the first efforts of any untutored youth; while others, such as the La Madelaine mammoth and the grazing reindeer from Thayngen, show the practised hand of the skilled draftsman. Among the fanciful illustrations introduced by M. Louis Figuier, in his "L'Homme Primitif," is a picture showing the arts of drawing and sculpture as practised during the reindeer epoch. Three men of fine physique, slightly clad in skins, stand or recline in easy attitudes, sketching or carving as a modern artist might do in the lighter hours of his practice. One stands and sketches a deer with free hand on a piece of slate, which rests against a ledge of rock as his easel. Another, seated at his ease, traces a miniature device with, it may be, a pointed flint, on a slab of bone or ivory. The third is apparently carving or modelling a deer or other quadruped. All are, as a matter of course, represented with the stylus, graver, or modelling tool in the right hand,—the question of possible left-handedness not having occurred to the modern draftsman.

In so far as evidence, based on the direction of the profiles in the drawings thus far noted, throws light on this subject, the following is some clue to the result. The Mammoth drawing from La Madelaine cave; the bisson, imperfect, showing only the hind-quarters; and the ibex, on reindeer antler, from Laugerie Basse; the group of reindeer from the Dordogne, two walking and one lying on its back; the cave bear of the Pyrenees, from the cave of Massat, in the department of Ariége; and another representing a hunter stalking the Urus,—these may all be regarded as right-hand drawings. But the horses from La Madelaine, engraved on reindeer-antler, specially noticeable for their large heads; the horse, from Creswell Crags; the ibex, with legs in the air; and, above all, the remark-

ably spirited drawing of the reindeer grazing, from Thayngen in the Kesserloch—a sketch, marked by incident, both in the action of the animal and its surroundings, suggestive of an actual study from nature,—all appear to be left-hand drawings.

The number of examples thus far adduced is obviously too small to admit of any general conclusion as to the relative use of the right or left hand being based on their evidence; but so far as it goes, it suggests a much larger percentage of left-handed draftsmen than is to be looked for on the assumption that right-handedness is the normal condition of man. It indicates, moreover, the importance of keeping in view the distinction to which attention has already been directed, between the preferential use of either hand by the cultured and skilled workman, or the artist, and its employment among rude, unskilled labourers engaged in such toil as may be readily accomplished by either hand. That the use of the left hand is transmitted from parent to child; and so, like other peculiarities, is to some extent hereditary, is undoubted. This has, therefore, to be kept in view in drawing any comprehensive deductions from a few examples confined to two or three localities. It may be that the skilled draftsman of the Vézère, or the gifted artist to whom we own the Kesserloch drawing, belonged to a family, or possibly a tribe, among whom left-handedness prevailed to an unusual extent; and so might be developed not only hereditarily but by imitation. But on the other hand, even among those palæolithic draftsmen, there is a distinct preference for the right hand in the majority of cases; and this is just what was to be expected. The more the subject is studied it becomes manifest that education, with the stimulus furnished by the necessities arising from all combined action, have much to do with a full development of right-handedness. There is considerable evidence in favour of the idea that in many children, if not indeed in the majority, there is no special natural bias leading to the preference for either hand. But with a certain number the preferential use of the right hand is natural and instinctive. Others again are conscious of an equally strong impulse to use the left hand. In the ruder conditions of savage life, where combined action is rare, there is little to interfere with the independent action of each, in following his own natural bias. But so soon as cooperation begins to exercise its restraining and constraining influences, a very slight bias, due probably to individual organic structure, will suffice to determine the preference for one hand over the other, and so to originate the prevalent law of dexterity. The results shown by the ancient drawings of Europe's cavemen perfectly accord with this. In that remote dawn every man did that which was right in his own eyes. Some handled their tools and drew with the left hand; a larger number used the right hand; but as yet no rule prevailed. In this, as in certain other respects, the arts and habits of that period belong to a chapter in the infancy of the race, when the law of dexterity, as well as other laws begot by habit, convenience, or mere prescriptive conventionality, had not yet found their place in that unwritten code to which a prompter obedience is rendered than to the most absolute of royal or imperial decrees.

VIII.—*The Five Forts of Winnipeg.*

By GEORGE BRYCE, M.A., LL.D.

(Read May 28, 1885.)

Five forts around which gather the most interesting events connected with the history of Rupert's Land and the Canadian Northwest were erected within what are now the limits of the City of Winnipeg. These were not mere continuations or renewals of the same fort; they were all built on different sites, and represented different important movements. These are: Fort Rouge, Fort Gibraltar, Fort Douglas, the original Fort Garry, and the recent Fort Garry. The first erection upon the future site of the metropolis of Northwestern Canada was Fort Rouge; this was built almost exactly one hundred and fifty years ago.

FORT ROUGE.—This small station of the French explorers, so named probably from its being on the Miskouesipi or Blood-red River of the Cristenaux aborigines, was hardly built and named before it was given up. The adventurous explorers found other points more suitable for the purposes of a rendezvous in their work of fur-trading and discovery. In addition to this, the fact of the Red Fort being on the south side of the Assiniboine exposed it to the incursions of the fiery bands of Sioux. The warpath of the Sioux from the river of the west (the Missouri) was along the south bank of the Assiniboine,—the very name of Assiniboine River meaning "River of the Stony Sioux," and showing the proximity of the dreaded Dakotas. Coming from the last port on Lake Superior in 1731, the adventurous French Canadian, Varennes de la Verandrye, and his sons dotted the margin of their watery way with hurriedly constructed forts or stations. At the exit from Rainy Lake are still to be seen the faint remains of Fort St. Pierre, built in the first year of exploration. Massacre Island on Lake of the Woods, on which a portion of de la Verandrye's party was murdered by the Sioux, was opposite a post erected on the south-west side of the lake, in 1732, with the name Fort St. Charles. The dashing waters of the Maurepas (now Winnipeg River) bore the voyageurs down to the lake, called, from its turbid waters, *Win-nipiy* or Winnipeg. Exactly in what year de la Verandrye ascended Red River and built his Red Fort, we do not know: probably 1735 is not far from the time. From investigating the maps of the daring fur-trader sent home to Paris, through the governor of New France, we learn of the short life of Fort Rouge. The following are some of the documents that attest its existence:—

(1.) In the archives at Paris is a map thus named: "Map containing the new discoveries of the west in Canada, seas, rivers, lakes, and the nations who dwell there, in the year 1737. Discovery of the western sea joined to a letter of M. Beauharnois, October 14th, 1737 (prepared by Varennes de la Verandrye)." On this map is marked a fort near the site of the present town of Portage la Prairie—"Maurepas," the name afterwards given to the

fort at the mouth of Winnipeg River. Half-way up Red River is a fort called "Pointe du Bois," some seventy-five or eighty miles south of the United States boundary line. At the mouth of the Assiniboine, where stood the Red Fort, there is marked a fort with the disappointing addition, "abandoned," showing that it could only have been occupied one year.

(2.) A map found in the Department of Marine, Paris, professing to be made after sketches by de la Verandrye, and claiming to be of date about 1740, gives Fort Rouge at the mouth of the Assiniboilles and on the south side of it. The direction of the Assiniboine is not quite accurate. (See Plate I. Map 1.)

(3.) Another map in Paris supplies a little further information. It is a "Map of the new discoveries in the west of Canada, prepared from the descriptions of M. de la Verandrye, and given to the Depot of Marine, Paris, by M. de la Galissoniere, 1750." In this map on the north side of the Riv. des Assiniboilles (*sic*) is given Fort de la Reine, where Portage la Prairie now stands. The lake is marked "Vnipigon." We again notice on the site of Fort Rouge, a fort marked and described as "Ancien Fort," fifteen or seventeen years having sufficed to give it its antiquity. In this map the direction of the Assiniboine is properly given. (See Plate I. Map 2.)

(4.) Thomas Jeffreys, Geographer to His Majesty of England, in a map and description in 1762, speaks of Fort Maurepas (on Lake Winnipeg) and Fort de la Reine (on the Assiniboine), and states that another fort was built on Rivière Rouge, but was deserted on account of its vicinity to the two named.

(5.) Another manuscript map in the Department of Marine, Paris, and bearing date 1750, figures a Fort Rouge on the Assiniboine at its mouth. In this map the direction of the Assiniboine is, again, somewhat wrong.

Of Fort Rouge no vestige now remains. The site of it must now, from the falling in of the banks of the Red and Assiniboine Rivers, be under water. A few years ago the writer ascertained from one of Lord Selkirk's colonists, who saw the locality in 1812, that there was not then a trace remaining of the Red Fort of seventy or eighty years before. Though the south bank of the Assiniboine at the point is now treeless, this informant says it was in 1812 fairly wooded. Undoubtedly the Red Fort, built in haste, and so soon to be abandoned, was little more than a rudely constructed log enclosure, erected on the clearing made just large enough to supply the material for its construction.

After the British conquest of Canada there is a break in the history of the Northwest. The change of rule paralyzed the fur trade of Montreal for a few years; but the love of adventure and the inducements of trade led Montreal merchants again to send their agents to the far interior. Three or four years after the Treaty of Paris in 1763, there is record of Montrealers penetrating by the canoe route even to the Saskatchewan. These were the merchants, Curry and Findlay. The rival traders from Hudson Bay built Fort Cumberland on the Saskatchewan in 1774. As to the occupation for trade of Red River itself, we know that Louis Nolin, whose descendants are still among the best of the Metis, arrived at Red River in 1776. Augustin Cadot, a Metis from Sault Ste. Marie in 1780, and Toussaint Vaudrie, a French interpreter, came about 1788. It was a necessity for each of the companies engaged in the fur trade to extend their agencies as far as possible, in order to counterwork each other. The Montreal traders further saw the necessity of combination if they would successfully oppose the Hudson's Bay Company. The union of Frobisher,

McTavish, McGillivray, Gregory, McLeod, and others took place in 1787, and we learn from the evidence of the Hon. William McGillivray that the first hold in a permanent form of the Red River district was taken in 1788. This statement is further corroborated by Alexander Henry, jun., a fur-trader, who, in 1800, journeyed along Red River. From him we learn that the first fort on Red River was built by a trader, Peter Grant. The fort was situated on the east side of Red River, a little south of the International boundary, and no doubt near the St. Vincent railway station. Henry in 1800 says that there were at this point "the remains of an old fort."

Fort Pembina on the west side of Red River, a little more than a mile south of the International boundary, was built by a North-West trader, Charles Chaboiller in 1797-98. Mr. David Thompson, the surveyor of the North-West Company, a man of great perseverance and marvellous endurance, gives an account of a visit to this post in 1798, at which time, though he passed the spot, he makes no mention of a fort at the mouth of the Assiniboine. At the time of his journey, which was made up Red River, there was a North-West fort sixty miles further up stream, at the mouth of Red Lake River, where now stands the town of Grand Forks, in Dakota. This fort was in charge of a French half-breed trader, Baptiste Cadot, the son of the celebrated old trader of Sault Ste. Marie, referred to by many writers of the period. Further up Red Lake River there was at this time a post also upon Red Lake, celebrated as being one of the supposed sources of the Mississippi. This was under the charge of a North-West bourgeois, John Sayer. It was a son of this trader who afterwards figured in the remarkable trial at Fort Garry in 1849, when the French half-breeds rose against constituted authority, and seized court-house, judge and jury. As an example of the hardships endured at these forts, Thompson tells us that the trader, Sayer, and his men had passed the whole winter on no more substantial food than wild rice and maple sugar. The Forts on Red River, in 1798, seem to have been Pembina, the Forks (Grand Forks), and Red Lake, all of them in what is now the United States. The approach to Red River would seem to have been made by the North-Westers by way of Rainy River, or even from Fond du Lac, on Lake Superior, and down Red Lake River. The union of the North-Westers and the X. Y. Company, who had been rivals since 1796, and to the latter of which Sir Alexander Mackenzie and Edward Ellice belonged, took place in 1804. An impulse was given to their trade, and seizing a leading position at the Forks of our rivers, they built a new post.

Fort Gibraltar.—The Hudson's Bay Company claim to have built a fort at Red River in 1799, but no trace of it remains. Possibly it may have been at the point a few miles below the Forks, afterwards taken up by the colony. It was in 1806 that the North-Westers erected their fort at a point, one old resident informs us, "within gun-shot of old Fort Garry," as it was afterwards built. Such a comparison is suggestive of the relations of the two companies, and certainly it was the warlike humour of the builders rather than the strength of the position that gave this fort its name. It faced towards Red River rather than the Assiniboine, and was situated below the site of the recently removed emigrant sheds. From the evidence of a resident of the colony, we know that, in 1818, this fort was about fifty yards back from the river. The same observer says the river was then 150 yards wide: it is now at this point about 200 yards; so that from each side of the river twenty-five yards have fallen into it. It will thus be seen that ten yards of the

fort have fallen down the bank. It was built by John Wills, a bourgeois of the North-West Company, with a force of twenty men: he was engaged for a year in building it. The stockade of Fort Gibraltar was "made of oak trees, split in two." The wooden picketing was from twelve to fifteen feet high. (See Plate II.)

The following is a list of the buildings enclosed in it, with some of their dimensions. There were eight houses in all: the residence of the Bourgeois, 64 feet in length; two houses for the servants, respectively 36 and 28 feet long; one store, 32 feet long; a blacksmith's shop, stable, kitchen, and an ice house. On the top of the ice house a watch tower (*guerité*) was built. John Wills, the builder, lived in charge of this fort until his death in 1814.

The great struggle between the Hudson's Bay and North-West Companies for supremacy in the fur trade, which had been proceeding with bitterness and determination during the last quarter of last century (1774-1800), and had risen to fever heat in the first decade of the present century, was brought to a crisis by an emigration movement of a most important kind. The Earl of Selkirk, though a stockholder of the Hudson's Bay Company, did not, as some have supposed, send his colony out as a means of securing the country for the fur trade. He was enthusiastic in emigration projects. In 1803, he sent a large and successful colony to Prince Edward Island. Before that date even, in 1802, as shewn by a letter sent by him to the Home Department, of which a copy is in the possession of the writer, he planned his colony to Red River; and Prince Edward Island was only selected before starting, because the British Government regarded it as more accessible. It was to gain the territory on which to plant a colony that his Lordship formed the great design of purchasing stock in the Hudson's Bay Company.

Lord Selkirk succeeded in carrying out all his plans; in 1811 he bought up a controlling interest in the company, and purchased a vast tract of what is now a part of Manitoba, and portions of the northern parts of Minnesota and Dakota. This was known as the District of Assiniboia. It was in 1811, as already said, that his representative, Mr. Miles Macdonell, a Highlander, formerly a Captain of the Queen's Rangers, was appointed Governor of the Hudson's Bay Company, and was also named by Lord Selkirk in charge of his colony. Mr. Macdonell arrived at Red River in the year 1812, and met the colony which had just come from Britain by way of Hudson Bay. It numbered about eighty persons. The new Governor and the colonists, in the year of their arrival, immediately began to erect houses; indeed some of the colonists were under a three years' engagement with Lord Selkirk to erect houses for the Company. These were situated about three quarters of a mile north of the junction of the rivers, east of Main Street, and between James and Logan Streets, probably on the edge of the broken plain skirting the belt of wood along the river. There was a house for the Governor, where also dwelt the sheriff. There were besides a farm house, a store-house, and several other buildings. Here the colonists lived, tents and huts being used as well. The well-known dwelling, with its fine surrounding of trees in the plot at the foot of Rupert Street,—the abode of the late Sheriff Alexander Ross, the historian of Red River—in its name "Colony Garden," still retained by it, commemorates the locality where the colony first took root.

It was the custom of the dwellers at the Forks to journey southward in the winter in order to be near the open country containing buffalo. The Governor had erected an establishment on the north side of Pembina River at its mouth, to which he gave the

name Fort Daer,—Baron Daer and Shortcleugh being one of Lord Selkirk's titles. Thither, for the winter of 1812-13, the colonists migrated. During the summer they returned to their establishments at the Forks, and their number was made up to one hundred by the arrival of a small band of new immigrants. During the next winter they again removed sixty miles southward to Fort Daer. It was while at Fort Daer with the colonists, that Governor Macdonell, becoming apprehensive that the supply of food for his expected colonists from Britain would run short, issued on January 8th, 1814, his celebrated proclamation, forbidding the export of pemican or other food from the country, but stating his willingness to pay for the food taken for the colony. This proclamation was drawn forth by the threat of the Nor'-Westers to starve the settlers out before they could get a foothold; for it was, indeed, said, that Nor'-Western agents had cruelly driven away the buffalo out of reach of the settlers when at Pembina.

In 1814, the settlers sowed a small quantity of wheat got from Fort Alexander, at the mouth of Winnipeg River, but it was all planted with the hoe. In 1814, the colony was increased by two additional parties by way of Hudson Bay. The first arrived on June 22nd, and was supplied with thirty or forty bushels of potatoes, which they planted. The lots for the several families were now selected, being narrow strips of land commencing a mile and a half from the junction of the river, and extending side by side along the river for three miles, after the manner of the buildings along the St. Lawrence in the Province of Quebec. At the close of 1814, the colony numbered two hundred persons. Acting under Governor Macdonell's proclamation, Sheriff Spencer, in May, 1814, seized at Assiniboine House, opposite Brandon House, one hundred miles or upwards west of the Forks, four hundred bags of pemican, each weighing between eighty and ninety pounds. He also took a considerable quantity of preserved buffalo tallow. The question as to whether the Governor acted rightly in making this seizure has been much discussed. All can now see that it was unwise, giving, as it did, a welcome opportunity to the Nor'-Westers to display their secret hostility. These measures, no doubt, caused much excitement among the Nor'-Westers, all the way from Athabaska to Montreal.

At their annual meeting in the summer of 1814, at Fort William, two of their most daring and astute partners were sent to the Red River and Assiniboine districts. These were Duncan Cameron and Alexander Macdonell, both of whom became celebrated in the stirring events of the period. Cameron took charge of Fort Gibraltar. The plan of the Nor'-Westers was first to induce the settlers to leave Red River and settle in Canada, and after that, or along with that, to drive out those refusing to accept their offers. Duncan Cameron, though said by one writer friendly to the Nor'-Westers, to have been of an "irritable temper," was, on the whole, well-suited to the task. Though possessed of no military rank he signed himself "Captain, Voyageur Corps, Commanding Officer, Red River." He wore a flowing red coat, and carried a sword. However, he was as adroit as he was bold. He could speak Gaelic, the native tongue of the colonists. He courted the favor of the settlers during the whole winter, invited them to his table, and at the same time awakened their fears by threatening them with the Indians, should they disregard his wishes. The winter of 1814-15 was a troubled one. Taking advantage on April 4th, 1815, of the temporary absence of the Governor, Mr. Archibald MacDonald being in charge, Cameron sent a party to the Governor's house to demand the cannon in possession of the colonists, saying, in his missive, that they were not for use, but in order to prevent their

being used. While one party was delivering the missive, virtually keeping the acting governor and those with him prisoners, another party seized the colonists' storehouse, broke it open and took all the artillery, consisting of eight field pieces—small swivel-guns and a howitzer.

When Governor Macdonell returned, he issued a warrant for the missing guns, but on resistance being offered, allowed the matter for the time being to rest. Those of the settlers who contemplated going to Canada, now deserted the colonists' houses and went to Fort Gibraltar. In May, 1815, a Nor'-Wester force seized the cattle of the colonists; while, on June 11th, an attack from the wood adjoining was made on the governor's house, lasting three quarters of an hour. The water communications throughout the country were now open. The colonists were thoroughly alarmed. The Nor'-Westers threatened loudly, and they were so manifestly masters for the time being of the situation, that Governor Miles Macdonell, with the advice of the other officers, surrendered himself, under a warrant that had been obtained from Canada against him for the pemican-seizure at the Assiniboine House the year before, and was taken to Canada, along with Sheriff Spencer for the same matter. One hundred and thirty-four of the colonists, induced by promises of free transport, and two hundred acres of land in Western Canada, deserted the colony in June, along with Cameron, and arrived at Fort William on their way down the lakes in the end of July. Those remaining of the settlers were now desolate indeed. The Bois-brûlés, who remained upon the spot, undertook to dispose of them. The following document was served upon them on June 25th, 1815: "All settlers to retire immediately from the Red River, and no trace of a settlement to remain." This was signed by Cuthbert Grant, Bostonnais Pangman, William Shaw, and Bonhomme Montour.

The settlers were accordingly compelled to retrace their road to Hudson Bay. On June 27th some thirteen families, comprising from forty to sixty persons, pursued their sad journey, piloted by friendly Indians, to the north end of Lake Winnipeg to the Hudson's Bay Company fort of Jack River, since that time known as Norway House, from the circumstance, it is said, that a number of Norwegians were brought out to that point to endeavour to introduce the reindeer as a beast of transport in Rupert's Land. A Hudson's Bay Company servant, named McLeod, and two or three men alone were left. The expulsion was now complete, and accordingly the day after the departure of the loyal few, the colony dwellings, with the possible exception of the Governor's house, were all burnt to the ground. The settlers had been compelled to leave their growing crops behind them. In July, they reached Jack River House, their future dark indeed! Lord Selkirk was true to his colonists in the hour of their danger. An officer, Colin Robertson, and twenty clerks and servants of the Hudson's Bay Company, were sent to the relief of the settlers. Arriving at Red River, Robertson found that the settlers had gone northward; he followed after them, found them at the foot of the lake, and encouraged by him, they returned to the blackened ruins of their establishment on August 19th, 1815. The crops left by the colonists, though partially destroyed, were in part preserved by McLeod and his companions. The courageous handful were rewarded for their perseverance by the arrival, in the month of October, of another party of their friends from Great Britain, so that now their numbers again rose to one hundred and fifty. The absence of a number of the Nor'-Westers with the deserting colonists left Robertson in possession of the field. The colonists began

to rebuild their destroyed dwellings, and looked forward with hope. The Governor's dwelling was strengthened, other buildings erected beside it, and, more necessity being now seen for defence, it assumed a more military aspect, and took the name Fort Douglas.

The blood of the members of both fur companies was now up. Cameron had returned in the summer of 1815 from the disposal of the deserting colonists, and from the meeting of the partners at Fort William, to await developments, and check new movements of the colonists. Alexander Macdonell, the Nor'-Wester, had returned and gone west to Qu'Appelle. In October, 1815, Cameron was seized along with Fort Gibraltar, and two of the river field-pieces recaptured. The matter was, however, settled and the fort restored to Cameron, who had been liberated. The further anxiety of Lord Selkirk for his colonists may be seen in the appointment of an experienced and capable military officer, Robert Semple, as Governor of Assiniboia. Governor Semple arrived at Red River in the autumn of 1815, alas, to make his grave on its banks. His arrival and presence gave much confidence to the settlers, and he was ably assisted by his lieutenant, Colin Robertson. Officials and settlers, as usual, spent the winter at Fort Daer.

The presence of the two daring Nor'-Westers in the country, Cameron and Macdonell, was reason enough for believing that there would be renewed trouble. All through winter threatenings of violence filled the air. The Bois-brûlés, or half-breeds, were arrogant, and led by Cuthbert Grant, a lad of little more than twenty, looked upon themselves as the "new nation." Returning after the New Year of 1816, from Fort Daer, Governor Semple saw the necessity for aggressive action. Fort Gibraltar was to become the rendezvous for a Bois-brûlé force of extermination from Qu'Appelle, Fort des Prairies (Portage La Prairie), and even from the Saskatchewan. To prevent this, Governor Semple captured the fort, and took Cameron into custody. This event took place, according to some, in March, according to others, in April, 1816. It is supposed that the Governor kept it as property taken in war, for, except on this ground, it is difficult to see how his action could have been justified.

Still in possession of Gibraltar, it was deemed wise to bestow Cameron, in a safer place. He was accordingly despatched as a prisoner under the care of Colin Robertson to Jack River House, on his way to Hudson Bay. By the failure of the ship to leave Hudson Bay, Cameron remained seventeen months a prisoner before he reached England, where he was released immediately on his arrival. He afterward returned to Canada, and represented the County of Glengarry for some time, probably between the years 1820 and 1830, in the Canadian parliament. No sooner had Cameron been taken away than there followed the destruction of Fort Gibraltar. Retaliation, the purpose of destroying what might give shelter to the attacking force, and perhaps the desire of profit, were the reasons for the destruction of Fort Gibralter. Colin Robertson, it is said, was determinedly opposed to the demolition. He is said to have seriously differed with Governor Semple on the subject. On the next day after Robertson's departure with Cameron, its fate was decided, and the buildings were pulled down in end of May, 1816. A force of some thirty men was employed ; and expecting, as they did, a body from the west to attack them, the work was all accomplished in seven or eight days. The materials were taken apart : the stockade was made into a raft, the remainder was piled upon it, and all was floated down Red River to the site of Fort Douglas. The material was then used for strengthening the fort, and building new houses in it. Thus ended Fort Gibraltar. A considerable establish-

ment it was in its time; its name was undoubtedly a misnomer so far as strength was concerned: yet it points to its origination in troublous times.

Fort Douglas.—We have said that the Hudson's Bay Company claim to have built a fort on Red River in 1799. No trace of it can be distinctly made out, though there seems to be a floating tradition that there was a Hudson's Bay Company fort somewhere near the site of Fort Gibraltar or, possibly, further down the bank towards the colonists' establishment. In 1812 and the subsequent years, however, their interests seem all to have been included in the Colony Fort. Whether the fur-trade interests were absorbed in Fort Douglas or not, the chief reason for strengthening the colony establishment was the protection of the settlers. From a mere scattered gathering of buildings, it was, by extensive buildings and repairs in the autumn of 1815, that it gained the name Fort Douglas, being so called after Lord Selkirk's family name. Probably one of the reasons for destroying Fort Gibraltar, was to provide material for the enlargement of Fort Douglas. We find that, during the same year, orders were given to bring down portions of the North-West Fort, which had been at Pembina, for the same purpose. It was stated that when Fort Gibraltar was destroyed, haste was made, lest the destruction should be interrupted by the arrival of the threatened Bois-brûlé invaders from Qu'Appelle. That invasion did take place, and we shall see that Fort Douglas, too, has its well-marked history.

Not more than three weeks had elapsed after the last beam of Fort Gibraltar had been removed, when, from the watch-tower of Fort Douglas, the alarm was given that the half-breeds were coming. This was about six o'clock in the evening of June 19th, 1816. The Governor immediately ordered a party to prepare to meet the intruders, who seemed to be avoiding the fort, and to be directing their movements against the settlers down the river. The Governor seemed to have intended to hold a parley with the approaching force. On perceiving, as he rode forward, that the party was larger than he had supposed, he sent back to the fort for a stronger force, and for a piece of artillery to be brought. He then proceeded some two miles down the river from the fort to a point since celebrated as the scene of the conflict of Seven Oaks. The half-breeds who were mounted now approached the Governor's party in the form of a half-moon, giving the war-whoop. One of their leaders named Firmin Boucher advanced towards the Whites, with the insolent cry, "What do you want?" The Governor replied "What do *you* want?" The answer to this was, "We want our fort,"—no doubt referring to the destroyed Fort Gibraltar. The Governor replied harshly, "Well, go to your fort!" A hurried rejoinder of an insulting kind being made to the Governor, he rashly seized Boucher's horse by the bridle, seemingly with the idea of making him a prisoner. As Boucher slid from his horse, a shot was fired from the Bois-brûlés' ranks, and one of the Governor's body-guard fell. The firing became general. The Governor fell by the second shot, wounded in the shoulder. Lying helpless, the Governor was given in charge of a French Canadian to assist him to the fort, when a worthless Indian along with the party, running up, shot him in the breast and killed him.

Completely destroyed, scattered, or terrified, there was no force of settlers or Hudson's Bay Company men sufficient to defend Fort Douglas. John Pritchard, afterwards a confidential agent of Lord Selkirk, conducted negotiations between some forty settlers at the fort and the half-breeds. The settlers at first proposed to defend the fort, but a wiser deter-

mination was reached. An inventory was made of all the Fort property, and on July 20th, 1816, the colonists capitulated, the fort was formally handed over, and a receipt given by Cuthbert Grant, acting for the North-West Company. Thus, in the varying fortunes of war, Fort Douglas, for a time, became the possession of the company, whose Fort Gibraltar was now a thing of the past. Festivities of an extravagant kind took place over the victory. Half-breeds and Indians held high carnival. Partners and their dependants from different parts of the country, rushed to Fort Douglas, which the Nor'-Westers held for the summer at least. The sorrowful, ill-fated colonists again took boat down the River to seek Hudson Bay. There being for the time no disturbance, the Nor'-West partners, set earnestly to work and completed Fort Douglas out of the material brought a few weeks before from their own dismantled Fort.

The news of the battle, of the death of the Governor, and of the seizure of Fort Douglas, caused the greatest excitement in Montreal, when the sad intelligence reached the headquarters of the North-West Company. Lord Selkirk with his family, had spent the winter there, and now was on his way up the lakes to his beleaguered colony. He had with him one hundred disbanded soldiers and thirty canoe men, who were to settle on Red River, and act as preservers of the peace. He arrived at Fort William in the autumn of 1816, spent the winter there, and in March, a portion of his settlers coming over the Rainy River route, left Lake of the Woods on snow-shoes, crossed the intervening country, and recaptured Fort Douglas in the spring of 1817, seemingly without much opposition. As soon as navigation opened, Lord Selkirk arrived (1817) at Fort Douglas, and laid the foundations for the colony firm and sure. This was the last of the conflict. Fort Douglas continued to be used as Governor's residence for years, though as we shall see, it soon ceased to be used for mercantile purposes. Governor Alexander Macdonell—called the "Grasshopper Governor," in allusion to the scourge occurring in his time—had charge from 1816-22. He was succeeded by Governor Bulger, a daring officer, and who is said to have left a collection of letters of great interest about Red River, known as the "Bulger Papers." He was Governor when Major Long's expedition passed down the river in 1823. The fort property was afterwards sold when the Company repurchased Lord Selkirk's rights, and was bought by Mr. Robert Logan, who occupied some of the buildings till 1854. Not a stick or stone of it now remains.

Old Fort Garry.—It is well known that the Hudson's Bay and North-West Companies, brought near the verge of bankruptcy, united in 1821. Just as the union of the North-West and X. Y. Companies in 1804 resulted in the building of Fort Gibraltar, so the union of the opposing parties now resulted in the building of a new fort. The site chosen was virtually that of the destroyed Gibraltar; it would seem to have been a little further up towards the Assiniboine. Here, after the union, the stores of the Company were opened, those at Fort Douglas having been closed. The situation of the old fort is believed to be near the present Hudson's Bay Company mill on the Assiniboine. Originally, a carriage road passed in front of it along the river. The greedy river, however, encroached every year; and now a portion of what was contained within the fort has been undermined and fallen away. The fort received its name from Nicholas Garry, an influential director of the Hudson's Bay Company, who, in 1822, as we learn from the "Bishop of Montreal's Journey to Red River," took a leading part in the management of the Company's

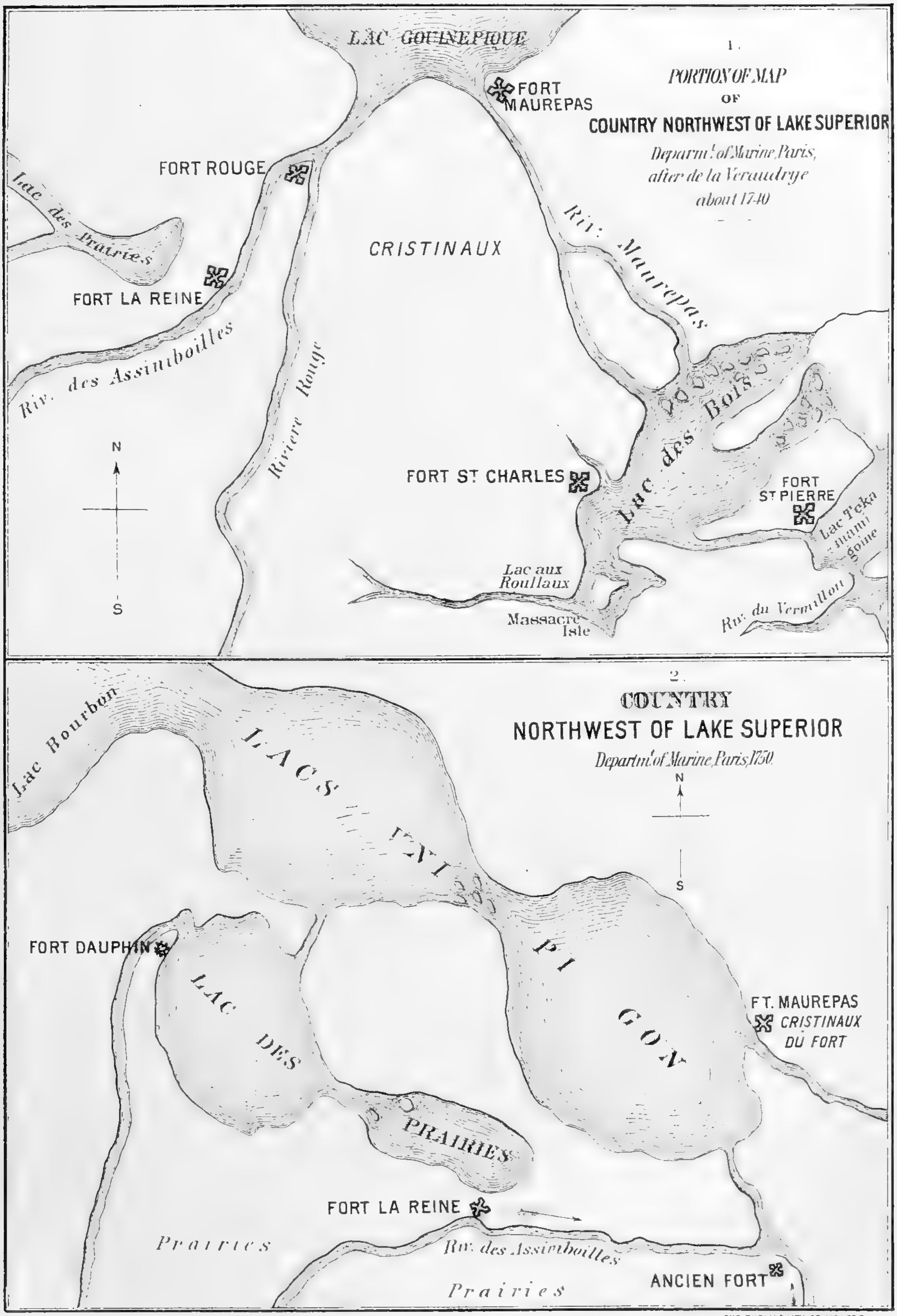
affairs. In 1823, Major Long, in his interesting work edited by Professor Keating, speaks of encamping near "Fort Gerry (*sic*), which is at the juncture of the two streams," and further, "the beautiful confluence of the Assiniboine and Red Rivers washed the base of the bluffs on which the fort stands."

That this fort was a very considerable establishment is known to us from the statement of an old resident of Winnipeg, who saw the old fort first in 1849. It was two hundred feet or upwards on each side. The master's house (or what had been used as such) was opposite the gate, and his office window looked out on the square enclosed. Along the square on each side were the necessary buildings, store, men's houses, carpenter and blacksmith's shops, storehouses, etc., for a large fur trade. Shortly after this, the river encroaching, the south-western bastion was undermined. One day an eye-witness saw that the dragon on the top of the wind vane was pointing at an angle of 60° rather than 90°; but the weight of the heavy log bastion enabled it to right itself, and it was not carried away. About 1852, the fort was pulled down. While this was going on, the occupants of the new fort were startled by a loud explosion. They supposed it to be a falling wall. It proved, however, to have been caused by three natives crossing the Assiniboine in a canoe. As was the custom, one was carrying powder in his handkerchief; he had set it in the bottom of the canoe; then sitting down near it, he thoughtlessly began to strike his flint to light his pipe. A stray spark ignited the powder. One of the men was blown on the shore; the other two, thrown into the water, were rescued with difficulty; while the canoe, torn to shreds, floated down the stream. Thus passed away the original Fort Garry, having had a much quieter history than the other Winnipeg forts.

Recent Fort Garry.—Recovering from the losses of war, the company began to thrive. The visit of Sir John Halkett, a relative of the Earl of Selkirk, and an executor, resulted in a rectification of abuses complained of by the settlers, and the vicious system of credit previously followed, was given up. This was in 1823. An increase of the population by a number of Swiss immigrants took place in 1821; but they emigrated again in 1827. In 1830, the Hudson's Bay Company began to feel the necessity for better accommodation, and for something more worthy of the name of a fort, for they were virtually the government of the country. In 1831 they built, at what they considered the head of river navigation, just below the St. Andrew's Rapids, a large and expensive establishment, since known as Lower Fort Garry. It is nineteen miles from Upper Fort Garry. The object would seem further to have been to place the centre of trade more in the midst of the English-speaking people, since the turbulent French half-breeds were settled near the Forks of the river. It was intended then to make it the seat of government.

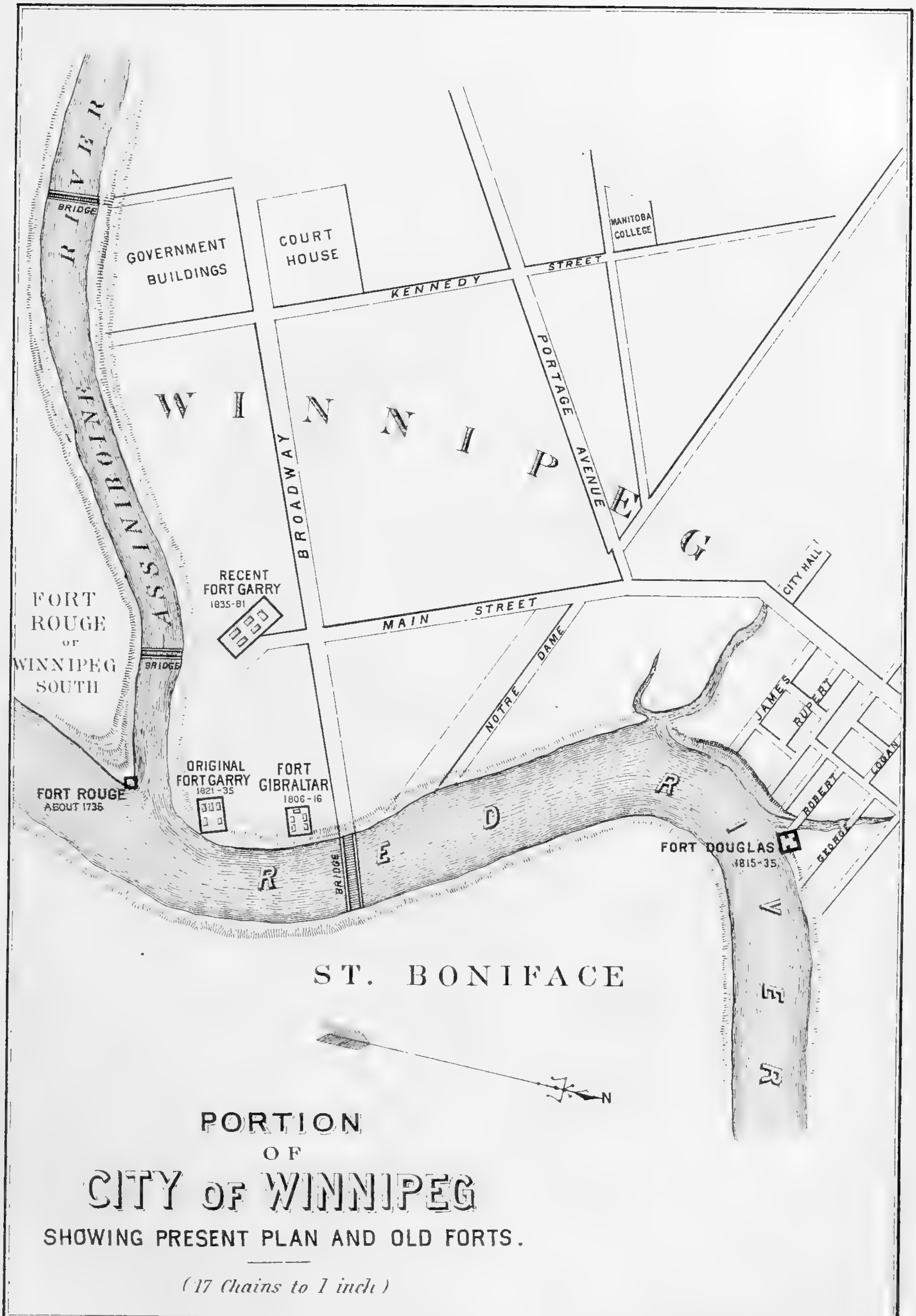
This policy was soon changed; and Governor Christie in 1835 began the large fort, till recently one of the land marks of Winnipeg, at the south end of Main Street. It contained not only the master's house, and a large number of extensive mercantile premises, but on the north side of it was also the residence of the Governor of the colony. There were also, within the enclosure, the court-house and jail. A substantial stone wall surrounded it when the writer first (1871) knew it. It was flanked by four bastions of solid masonry. This fort has seen many stirring scenes since 1835: the wild fury of the half-breeds at the Sayer trial (1849); the entertainment of numerous distinguished

guests ; the rebellion of Riel in 1869, when it was seized by the half-breeds, and where a large band of Canadians were held in it as prisoners; the mad execution of Scott, just outside its walls, on the south-east side; the removal of the wounded man to the south-west bastion, and his secret removal thence to an unknown grave. The northern gate still remains, a fine specimen of castellated masonry. The fort was 240 feet long from north to south, and 280 feet wide. Here the Council of Assiniboine met from the time of its organization in 1835 until the Rebellion in 1869. In former times, during the absence of a church in Winnipeg, religious service was held within the walls of the fort. It was sold by the Hudson's Bay Company in the inflation of 1882 for an enormous sum ; and, shame to the vandalism of modern commerce, it has been partly removed to straighten Main Street ; most of its buildings are unoccupied; and, alas! all of those occupied are the headquarters of the Winnipeg Street Car Company. The glory of the Winnipeg forts has departed !



THE BURLAND LITH CO MONTREAL.

To illustrate Prof. Bryce's Paper on the Five Forts of Winnipeg.



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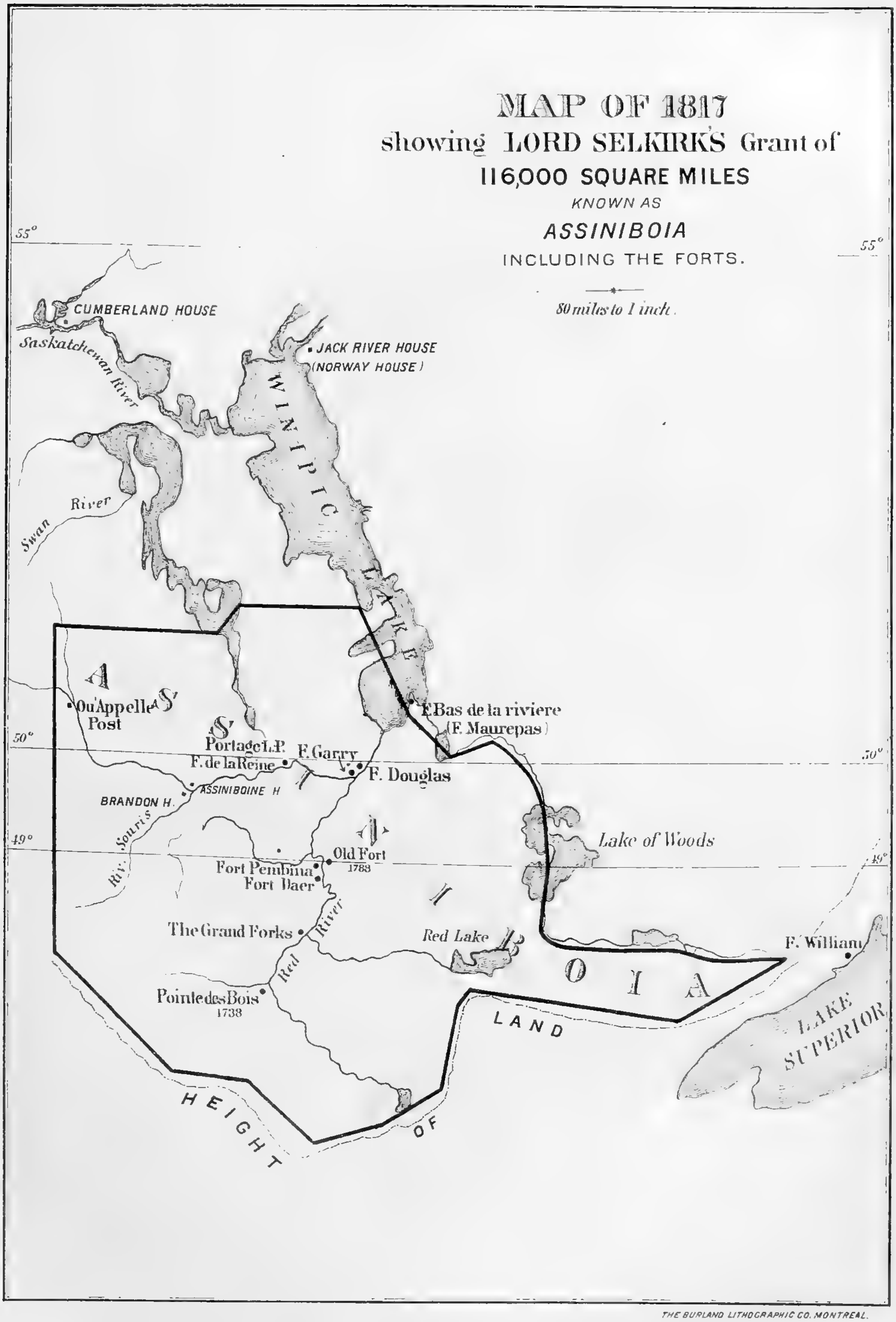

To illustrate Prof. Bryce's Paper on the Five Forts of Winnipeg.

ROYAL SOCIETY OF CANADA

TRANSACTIONS

SECTION III.

MATHEMATICAL, PHYSICAL AND CHEMICAL SCIENCES

PAPERS FOR 1885.

I.—*Presidential Address.*

By ALEXANDER JOHNSON, LL.D.

(Read May 26, 1885.)

At the annual meeting of a Society such as this, it is customary to take some notice of any changes that may have occured in its *personnel*. In this Section we have, happily, none to record, and I think it matter for thankfulness that we meet again with unbroken ranks, with no need for sad obituary notices such as have fallen to the lot of other Sections.

Taking up, therefore, the most important facts connected with the progress of Science, it is impossible to overlook an event, which has already been frequently referred to in Canada,—I mean the meeting of the British Association in Montreal last autumn. It is natural for this Society, and more especially for this Section, to refer to this event with something more than a passing notice. For, if that visit is to give the impulse to the progress of Science in Canada, which is one of the objects of the Association, then the scientific sections of this Society, especially, ought to be agents, if possible, to some extent in giving it.

Our own Section, in two at least of its three departments, has probably received more encouragement than any other from the visit. For, while men of the highest eminence in all the Sections of the Association were among the visitors, it happened that there was such a preponderance in Mathematics and Physics, that an American journal (*Science*) was inclined to call it a "Section A meeting."

The object of the Association in migrating from one place to another is, of course, to give a local stimulus to science. This may be seen stated in the records of its earlier, and probably in those of many later, meetings. But we are not left in any doubt on the matter, or required either to speculate on the subject or to search through historical documents, to show this. In the President's Address it is very plainly stated. Lord Rayleigh says: "In the Old World and in the New, recruits must be enlisted to fill the place of those whose work is done. Happy should I be if, through the visit of the Association, or by any words of mine, a larger measure of the youthful activity of the West could be drawn into this service. The work may be hard, and the discipline severe; but the interest never fails, and great is the privilege of achievement."

I suppose no one will doubt that, if it devolves on any Society specially to consider what can be done to attain the object of the Association, it belongs to the Royal Society of Canada acting through the several Sections. It becomes us, therefore, in this Section, to consider how we—not merely individually, but as a body—can aid towards the end proposed. The aspirations expressed by Lord Rayleigh were perhaps not necessary to us as a spur, but they are useful as an encouragement, as evidences of sympathy, and as drawing

the attention of the people of Canada, more powerfully than a Society so young as this can be expected to do, to the Advancement of Science.

How can we best try to advance Science? I think there can hardly be a member of this Section who is not aware of the difficulties that beset our work in a country so young as Canada. I mean *our* work especially, and more particularly in Mathematics and Physics, not Science in General. The Natural Sciences are far more favorably placed, a fact which was recognized by Lord Rayleigh in his Address.

The reason is, of course, obvious. A new country offers a new and wide field for investigations in Natural Science; while Literature and History are generally attractive studies that can find subjects everywhere. Now, I am afraid we cannot say that Mathematics is a popular study; at any rate the taste for it is less general than for other branches of Science, and its cultivation in the higher departments requires a long and expensive preliminary training, for which, in a new country, not only is there no adequate subsequent reward, beyond that of the acquisition of the knowledge and the training, but there is, even, positive discouragement, in as far as the man who has pursued this study in a university course is compelled to abandon it afterwards,—partly through the pressure of the daily avocations by which he earns his living, and partly through the want of associates with similar tastes in his own locality. Not until Canada can make some such provision as is found needful in other countries, can we expect to find its youth able to take up Mathematics with any thoroughness. This Society, it appears to me, may do something to hasten the arrival of that time, by drawing public attention to the need.

Physics, again, is becoming more and more closely connected with Mathematics, and therefore likely, to this extent, to be withdrawn from general cultivation. Both this and Chemistry share in the difficulties which arise from the necessity, in many cases, for expensive apparatus.

The Society has, through a special committee, been making inquiries as to the manner in which encouragement is offered in other countries, or other divisions of the Empire, to young men of adequate talent, to induce them to enter upon a scientific career. What result may arise from the Report laid before the Society, it is impossible to forecast. But the subject should not, I think, be lost sight of. It might be well even to go farther than this, and to keep continually before us one of the three objects for which the British Association was founded, which is stated in these words in every one of its Annual Reports: "To obtain a more general attention to the objects of Science and a removal of any disadvantages of a public kind which impede its progress."

Possibly no better way of pointing out such disadvantages in Canada for the purpose of subsequent removal could be found, than by a Report which would give an account of our present scientific resources in all the branches of this Section, viz., Mathematics, Physics and Chemistry,—in other words, of the present state of these sciences in Canada. I do not mean merely an account of laboratories and of collections of scientific apparatus, though these are important, but also of the number of posts in Canada open to scientific men, whether in Universities or under Government, of the salaries attached to them, and of the number of hours of daily work involved, so as to enable competent judges to form an opinion on the opportunities and facilities for original investigation; other practical information might be added. The British Association appointed a Committee in 1868 to make a Report, somewhat of this kind, for Great Britain

and Ireland. The last topic mentioned above, viz., the number of hours occupied daily with work, is of especial importance with regard to our Universities. The open discussion of this subject may draw attention to the immense disadvantage under which Science labours here, where one man has to undertake a great number of distinct branches—has to lecture, for example, as is commonly the case in Canada, on all branches both of Mathematics and Physics.

On this subject, I cannot do better than quote the words of Lord Rayleigh who, speaking of Physics alone, says: "It may be expected, that I should attempt some record of recent progress in that branch of Science, if indeed such a term be applicable. For it is one of the difficulties of the task that subjects as distinct as Mechanics, Electricity, Heat, Optics and Acoustics, to say nothing of Astronomy and Meteorology, are included under Physics. Any one of these may well occupy the life-long attention of a man of Science, and to be thoroughly conversant with all of them is more than can be expected of any one individual, and is probably incompatible with the devotion of much time and energy to the actual advancement of knowledge. Not that I would complain," he says, "of the association sanctioned by common parlance. A sound knowledge of at least the principles of general Physics is necessary to the cultivation of any department."

The possibility of the combination of all the branches of Mathematics as well as of Physics in a single University chair, does not appear to have occurred to him at the time of his Address. If he had knowledge of the fact, as occurring in Canada, he certainly refrained from any allusion to it. But there is some hope, even here. Whatever may be said of the question of University federation or consolidation, on other grounds, and I confess for myself that I have not studied the literature of the subject, there can be no doubt that an immense stride would be made in favour of Science, if a number of the present Universities of Canada could be concentrated in one city, and would divide the work of lecturing on scientific subjects amongst them for the benefit of students in general; so that Professors could devote their attention to special branches, and have time to spare to pursue original research in them.

A report of the kind I have referred to, on the present state of Science in Canada, might possibly be useful in another way, namely, in forming the foundation for an application either to the Dominion or Local Government for aid of various kinds. Applications to Government form one of the recognized means by which the British Association endeavours to promote Science. In the United States, the American Association acts on this principle, as may be seen from the following extract from *Science*, for September 5th, 1885 :—

"Rarely is there a meeting of the Association which does not afford striking examples of the relations of Government to Science, and of the importance of securing to the public the results of prolonged research. Astronomy, Geology, Geodesy, certain branches of Physics, Ethnology, and now Biology, through the admirable studies of the United States Fishery Commission, receive their most generous encouragement from the national Government. To make the same assertion in another form, we may say, that an enlightened people insists upon it, that Congress shall secure, for the good of all citizens, whatever results can be obtained by the liberal employment of Science in the public service. More than this, individual citizens have discovered that there is no better use for wealth than by endowments like those which are annually added to the educational resources of the country."

These relations between Government and Science would, no doubt, be more readily

established if the practical advantages arising from the cultivation of pure Science could be kept steadily before the public eye. The case of the general public might be similar to that of the illustrious Helmholtz, who, pursuing his researches in Physiology, found a deeper study of Physics necessary, and in order to master Physics, was compelled to take up Mathematics, becoming finally an original investigator in all. Thus the cultivation of the most abstract of the Sciences might be more extensively encouraged for the sake of the beneficial results in the Applied Sciences. The practical applications of electricity especially are likely to have a good effect in this way at the present day.

If we in this Society could bring forward, or induce others to bring forward (for it is to be remembered that the reading of papers is not limited to members of the Society, and we ought, I think, to exert ourselves in our several localities to induce competent men to take up their special subjects and present papers written here)—if, I say, we could get members or others to take up practical subjects to a considerable extent, without neglecting what is really more important for progress, viz., the purely scientific studies, we might expect a favorable influence on the cultivation of pure Science. Subjects special to Canada might rank in the foreground, such, for example, as the utilization of the water power of the St. Lawrence for the production of electric light, referred to by Lord Rayleigh; or, again, the investigation of the most troublesome phenomena of frazil ice, which yearly causes a great loss to the country. Descriptions of facts and phenomena in the Physical Geography and Meteorology of the country might also be valuable. Having thus sketched, hastily and imperfectly, a general outline of the manner in which we might possibly aid best in the progress of Science, I proceed next to make note of something which has been done.

An event of not only scientific but international importance, which this Society and this Section have taken some part in bringing about, is deserving of special mention on the present occasion, because it has actually been accomplished mainly by the energy of one of the members of this Section, supported strongly by the Founder and first Patron of the Society, the late Governor-General, the Marquis of Lorne. In the month of October last, at the invitation of the President of the United States, a conference was held at Washington to consider the question of choosing a Prime Meridian for all the world. The conference was composed of delegates from twenty-five civilized nations. We can well imagine that the conference was prolonged in consequence of the use of so many different languages as were there represented, and the necessity for frequent translations, that all the delegates might understand the proceedings. But at length the following Resolution was unanimously adopted:—

" *Resolved*,—That the conference proposes to the Governments here represented, the adoption of the meridian passing through the centre of the transit instrument at the Observatory of Greenwich as the initial meridian of longitude."

After this, another Resolution, relating to a Universal Day, was passed without a single dissenting vote, viz:—

" *Resolved*,—That this Universal Day is to be a mean solar day; is to begin for all the world at the moment of mean midnight of the initial meridian, coinciding with the beginning of the civil day and date of that meridian; and is to be counted from zero up to twenty-four hours."

The history of proceedings which led to such action as this, cannot but be interesting

in the annals of Science, and for the reasons already stated must be specially interesting to this Society and to Canada. I shall therefore give a slight sketch here, referring those who desire full details to a pamphlet on the subject, which is, I am happy to say, shortly to be published by the Canadian Institute of Toronto.

The desirability of having one common Prime Meridian had, of course, long been felt by civilized nations, and the inconvenience of the incessant changes of time in going from one city to another must have been a matter of thought to many, especially on this continent, with its long lines of railways, and great distances travelled by passengers on them. This has probably led to writings from time to time in one periodical or another, many of which might possibly be found, if diligent search were made for them.

To Mr. Sandford Fleming belongs the credit, not only of conceiving the idea of a remedy for the inconvenience, but of carrying it out to practical conclusions by one sustained effort. He introduced the subject before the Canadian Institute, in January and February, 1879. The proceedings of the Institute were subsequently brought, in the form of a memorial, before His Excellency the Marquis of Lorne, Governor-General, in the hope that he would lay them before the Imperial Government. Through his good offices, and the action of the Imperial Government, copies of the Proceedings were distributed to some of the leading scientific Societies in Great Britain, and to the governments not only of many European nations, but even of Japan and China.

In the year following, 1880, the American Metrological Society issued a Report of the Committee on Standard Time, bearing date May, 1879. In this Report, attention is drawn to the fact that through the influence of the then Astronomer Royal, Sir George Airy, the notation of time had been made synchronous in Great Britain, and it pointed out the inconveniencies in America for want of similar action. Advance copies of this Report were obtained in 1880 from New York, and, again through the kindness of the Marquis of Lorne, were sent, along with a second issue of Mr. Sandford Fleming's papers, to some of the leading European Societies. In consequence of this action of the Marquis of Lorne, general attention seems to have been drawn to the subject in Europe. Scientific men of various nations wrote on it. In Spain, all the papers sent from Canada were translated and published. This general attention prepared the way for a discussion at the International Geographical Congress at Venice, in which Mr. Sandford Fleming took part. He there suggested the idea of an International Conference to be held at Washington. Out of this discussion appears to have sprung another important discussion at the meeting of the International Geodetic Association at Rome, in October, 1883, when a special International Conference for the establishment of a Zero Meridian for Longitude and Time was recommended.

In June, 1881, the subject was considered at Montreal by the American Society of Civil Engineers meeting there, and a Committee appointed to consider it. A circular from the Secretary of that Society, dated March, 1882, was issued to the leading men connected with railways, and to scientific men on this continent. Replies were reported at a Convention of the Society held in May, 1882, and in consequence of their favourable character it was resolved to petition Congress to take the matter into consideration. This petition was supported by another from the American Metrological Society. The consequence was, that a joint resolution was passed by the House of Representatives and Senate, authorizing the President to call an International Conference to decide the question. The subject was

discussed in Montreal again, at the meeting of the American Association for the Advancement of Science in August, 1882. The Royal Society of Canada, as we know, has, on two occasions, co-operated by memorials in furthering a solution of the problem.

Meanwhile, before the International Conference could be assembled, the leading railways took action in the matter to suit the public convenience, so far as they were concerned, and in November 18th, 1883, the new system of regulating railway time on this continent came into operation. Nearly a year afterwards, namely, last October (1884), the International Conference already referred to, was held. The delegates appointed by the Imperial Government to represent Great Britain were: Professor J. Couch Adams and Sir Frederick Evans, the late Hydrographer to the Admiralty; General Strachey, Chairman of the Meteorological Committee, to represent India; and Mr. Sandford Fleming to represent Canada. The meeting of the British Association in Montreal, in August and September last, had made the attendance of these gentlemen an easy matter. To the same cause was due the presence of Sir Wm. Thomson, who was invited to be present and take part in the discussion. The result has already been stated.

It is a satisfactory coincidence, that at the same meeting of our Society, at which we are able to record this general adoption of Greenwich as the one Prime Meridian from which to reckon longitude, we should have a paper before us, giving an account of observations and calculations for determining more accurately than ever before, the longitude reckoned from Greenwich, of one station in Canada, viz., Montreal, from which, probably hereafter, all Canadian longitudes, will be determined; a beginning of which process is offered to us in the redetermination of the longitude of Toronto, and the determination ot that of Cobourg. The origin of this redetermination of the longitude of Montreal, is to be assigned to the late Transit of Venus, reports of observations on which have already appeared in the Transactions of the Society; and it is due to the courtesy and liberality of Professor Pickering, the Director of the Harvard Observatory (the longitude of which from Greenwich has been determined with special care), that Professor W. A. Rogers, of that Observatory, has been enabled at the expenditure of a great deal of time and labour, acting in concert with Professor McLeod of McGill College, to carry out the work.

It may be remarked, too, as an instance of co-operation in Science produced by the meeting of the British Association, that three of the five delegates representing the British Empire at the Conference of Washington were connected, in one way or another, with this Society. One was a member, and two others, Professor J. Couch Adams and Sir Wm. Thomson, were and are members of a Committee for promoting tidal observations in Canada, in favour of which the Council of this Society has petitioned Parliament, and in promoting which members of this Section have taken an active part.

II.—*Blowpipe Reactions on Plaster of Paris Tablets.*

By E. HAANEL, Ph.D., Victoria University, Cobourg.

(Read May 25, 1885.)

I.—OSMIUM WITH HYDRIODIC ACID.

Osmium gives with hydriodic acid on tablet a characteristic greyish-green volatile coating. The colour of this coating is best observed after the brownish coating, resulting from the decomposition of the hydriodic acid during the operation, has evaporated. The coating is not affected either by ammonia or ammonium sulphide. The reaction is sensitive. The three hundred and eighty-fourth part of a grain of osmic acid gave a very distinct coating. A specimen of iridosmine from Nishnei Tagilsk gave a coating extending two and one-half inches beyond the assay.

It is evident that a reaction depending on sight for the recognition of a substance is much to be preferred to one depending on the sense of smell, since the latter is unfortunately in very many persons either periodically or permanently impaired. For this reason the reaction of osmium with hydriodic acid will advantageously replace the one now in use in Blowpipe Analysis, which depends on the perception of the odour of the osmic acid evolved, and which has, therefore, always been unsatisfactory.

II.—REACTIONS ON TABLET FOR CHROMIUM, ANTIMONY, AND MOLYBDENUM WITH TETRACHLORIDE OF TIN.

MANIPULATION.—Fuming tetrachloride of tin is dropped upon the assay contained in the shallow cavity bored near one end of the tablet. The tablet is held in an inclined position; and the assay, in the case of examination for chromium is *gently* heated with the O.F., in case of examination for antimony and molybdenum it is more highly heated.

RESULTS.—Chromium and most minerals containing chromium give a peach-blow coating, which disappears entirely and at once when touched with the R. F., but reappears with its former intensity and tint when treated with a good O.F., This disappearance and reappearance may be repeated with the same coating any number of times. The coating is not affected either by ammonium or ammonium sulphide. Its production requires some skill. If the assay be too highly heated, the coating fails to appear. The operation should, moreover, be concluded the instant the coating appears, since further blowing tends to cover the coating with a white opaque film due to the tetrachloride of tin. The solid hydrate cannot be substituted with advantage for the fuming liquid tetrachloride of tin,—the coating either failing to appear, or being too feeble with the hydrate.

Antimony gives a purplish-black not very volatile coating, which is not affected either by ammonia or ammonium sulphide. This reaction is very sensitive and very satisfactory, and may serve to differentiate between the iodide coatings of arsenic and antimony. The reaction is equally satisfactory with the solid hydrate of the tetrachloride of tin. When the hydrate is employed, it is advantageous to place a small lump of the reagent, not upon the assay, but on the side of the assay nearest the flame, and to cause the O. F. to sweep over both, so that the fumes of the reagent may pass over the heated assay.

Molybdenum gives a greenish-blue coating, not to be confounded with the antimony coating. The coating is valueless for analytical purposes, since its production is very uncertain. It is mentioned to prevent its being mistaken for the antimony-coating in case it should make its appearance.

III.—*On some Iron Ores of Central Ontario.*

By E. J. CHAPMAN, Ph. D., LL.D.

(Read May 28, 1885.)

The series of analyses, embodied in this communication, refer to magnetic and other iron ores—obtained, in almost every instance, by the writer, personally—from mines or exposures in the Counties of Haliburton, Peterborough, and Hastings, in the Province of Ontario. The analyses are accompanied by brief notices of the general character and conditions of occurrence of the ore-deposits from which the samples were taken ; but in many cases, it should be observed, the totally undeveloped nature of the ground prevents detailed statements from being given. If thought of sufficient interest to be accorded a place in the Transactions of our Society, these analyses—supplementing those of other ores from this region, already published by Dr. T. Sterry Hunt, Mr. Thomas Macfarlane, and Dr. B. J. Harrington,—will serve at least to shew the vast abundance of iron ore, for the greater part of pre-eminently good quality, contained within a very limited section of the Province, alone. And it must not be supposed that in the iron ores which form the subject of the present communication we have examples of all, or anything like all, the ore-deposits of the district. Many others are known, and discoveries of additional deposits are constantly being made. When to these, therefore, are added the known workable deposits of adjacent districts, without taking into consideration the valuable iron ores of other Provinces of the Dominion, we may well admit the truth of Sir William Logan's prediction that Canada is destined to become eventually one of the greatest iron-producing countries in the world.

The geological horizon of these iron-ore deposits is that of the middle portion of the Laurentian series which occupy that section of Ontario. Briefly, the area is traversed in a general N.E. and S.W. direction by belts of elevated, rocky land, consisting of unstratified, probably eruptive, syenites or syenitic granites of a prevailing red colour. Between these belts lie rugged tracts, of essentially synclinal structure, occupied in ascending order by strata of red and grey gneiss, poor in mica, and by some crystalline graphitic limestones ; succeeded more or less irregularly by dark green amphibolic and pyroxenic rocks with which the iron ores are chiefly associated ; whilst these again are followed by micaceous and slaty beds, crystalline limestones, quartzites, and conglomerates,—the entire series being overlaid, here and there, by outlying patches of Lower Silurian limestone.

In the following analyses, where the ferrous and ferric oxide has been separately determined, the latter, it will be seen, is nearly always slightly in excess of what it should be to form, with the amount of ferrous oxide, pure Fe^3O^4. This arises from the ore, as a rule, being more or less peroxidized, especially when taken in unbroken ground from near the surface. The localities of the ores, and their general conditions of occurrence, are given in the notes following the table.

I.—Magnetic Ores, Free or Practically Free from Titanium.

No. of Ore. See below.	FeO.	Fe^2O^3.	MnO.	S.	P.	Siliceous Rock-matter	$CaCO^3$.
1	26.20	58.72	....	0.16	0.01	15.02	....
2	24.87	58.35	0.13	0.04	0.08	15.58	....
3	76.72		0.11	0.08	0.02	23.84	....
4	69.62		....	tr.	tr.	29.94	0.48
5	86.83		tr.	tr.	tr.	13.27	....
6	86.46		1.27	tr.	0.01	12.18	....
7	76.12		....	tr.	tr.	23.80	....
8	30.06	67.14	....	tr.	tr.	2.74	....
9	30.08	67.27	....	tr.	tr.	2.58	....
10	27.22	61.56	....	0.04	tr.	11.13	....
11	27.14	60.82	....	0.03	tr.	11.54	0.61
12	28.40	67.23	tr.	0.03	0.04	3.32	0.87
13	25.79	57.52	tr.	0.52	tr.	15.54	....
14	26.68	59.71	....	0.38	0.03	13.16	0.11
15	29.47	65.68	....	0..07	0.01	4.74	....
16	26.12	65.20	....	0.09	0.02	8.48	....
17	28.32	63.24	....	0.02	tr.	8.36	....
18	29.18	64.95	....	0.13	0.01	5.66	....

No. 1. A fine-grained, magnetic ore, from the Howland Mine, lot 26, concession 4, township of Snowdon. The ore near the surface is very pyritous, but becomes almost free from pyrites in descending. The sample was taken from a depth of eighty-one feet from the surface. A second shaft has been sunk on another part of the deposit to a depth of about thirty feet. The amount of metallic iron, in the sample analysed, corresponds to 61.48 per cent. The siliceous rock-matter is essentially pyroxene mixed with a little quartz. The amount found in the analysis consisted of: SiO^2 7.71, Al^2O^3 0.23, FeO 0.72, CaO 3.67, MgO 2.69=15.02. The deposit is apparently an elongated stock-formed mass of large extent. It has been opened over a length of about eighty feet.

No. 2. A black, magnetic, fine-grained ore, somewhat porous in texture, from the Victoria Mine on lot 20, concession 1, township of Snowdon. The deposit is apparently a stock-formed mass of large size, as shown by recent borings and excavations. The erection of a 30-ton charcoal furnace has been commenced on the ground. The analysis, as given in the table above, shows a deficiency of nearly one per cent. This is due in chief part to the omission of 0.73 per cent. titanic acid, found in the analysis. An amount of 0.42 soluble alumina has been added to the rock matter in order to simplify the table. The amount of metallic iron equals 60.18 per cent. In other analyses, the percentage has been found to

oscillate between 57 and 65. The insoluble rock-matter contained SiO^2 11.17, MgO 2.56, CaO 1.43 = 15.16.

No. 3. Magnetic ore from lot 25, concession 4, township of Snowdon. The ground is practically undeveloped. Metallic iron = 55 per cent. Intermixed rock-matter essentially pyroxenic.

No. 4. Magnetic ore, very like No. 3, from lot 27, concession 4, township of Snowdon. Metallic iron, 50.41 per cent. Ground, practically undeveloped.

No. 5. Magnetic ore from lot 27, concession 14, township of Galway. The ground is practically undeveloped. The ore is fine-grained in texture and of very good quality. Metallic iron 62.87 per cent.

No. 6. Magnetic ore, very similar to No. 5, from lot 23, concession 12, township of Galway. Metallic iron 62.60 per cent. Ground undeveloped beyond a few shallow trial pits.

No. 7. A soft, black, magnetic ore, from lot 5, concession 6, township of Lutterworth, about three miles west of Kinmount village. The deposit, to all appearance a stock-formed mass, has been partially opened, and about 300 tons of good ore have been taken out; but latterly the working has been discontinued.

No. 8. A black, crystalline, highly cleavable ore, from lot 27, concession 13, township of Glamorgan. It holds 70.38 per cent. metal, no trace of titanium, and merely traces of phosphorus and sulphur. The ground is quite undeveloped, but there are a few exposures; and needle attractions show a strong body of ore, ranging N. 65° E., over a length of about 400 feet by 40 feet in width. A second, and apparently isolated deposit of similar character, occurs on another part of the same lot.

No. 9. This ore, from lot 30, concession 13, township of Monmouth, corresponds almost exactly in its cleavable structure and its composition with the ore, No. 8 from Glamorgan, although the two deposits are several miles apart. The ground is practically undeveloped. Samples taken from a small trial-pit show 70½ per cent. iron, with rock-matter under 3 per cent.

No. 10. A black, partly crystalline, partly granular ore (sp. gr. 4.01) from lot 19, concession 1, township of Belmont. The rock-matter is essentially pyroxenic, and hence practically self-fluxing. Metallic iron 64.26 per cent. Ground undeveloped.

No. 11. A black, fine-granular ore, from the vicinity of Apsley village, in the northern part of the township of Burleigh. Metallic iron 63.68 per cent. Intermixed rock-matter essentially pyroxenic. Ground undeveloped.

No. 12. A very rich, magnetic ore, from lot 25, concession 6, township of Madoc. The sample contained some ochreous patches, hence the Fe^2O^3 is slightly in excess. Metallic iron in the dried ore, 69.16 per cent. Intermixed rock matter, 3 to 4 per cent. The deposit, apparently a stock-formed mass, shows magnetic attractions over an area of about 200 feet by 40 feet; but beyond a few trial-pits, from which about 150 tons of ore have been taken, the ground remains undeveloped.

No. 13. A magnetic ore, mixed with specks of actinolite, from the Seymour Mine, lot 11, concession 5, township of Madoc. The sample contained nearly 1 per cent. pyrites. Metallic iron 60.32 per cent. The intermixed rock-matter (15.54 per cent.) consists of: SiO^2 9.02, MgO 4.17, CaO 2.13, FeO 0.22. A purer sample of ore from this mine was analysed, some years ago, by Dr. T. Sterry Hunt, with the following results:—Fe^3O^4 89.220

P 0.12, S 0.073, Insoluble rock-matter 10.420. ("Descriptive Catalogue of the Economic Minerals of Canada," 1876).

No. 14. Sample from "Ledge 2" of the Seymour Mine. Magnetic ore, with slightly greenish-tinge. Metallic iron 62.54 per cent.

No. 15. A dark, fine-grained magnetic ore, from the Dufferin Mine, lot 18, concession 1, township of Madoc, extending into lot 18, concession 11, township of Marmora. This deposit is apparently an ore-stock of very irregular form. An open cutting to a depth of about 30 feet has been carried down upon it, and a good deal of very excellent ore has been taken out, but no systematic mining, has hitherto been attempted. The sample showed 68.90 per cent. metal, with rock-matter under 5 per cent. and no trace of titanium. Another, but smaller, sample, taken from the bottom of the excavation, held only 3.68 per cent. siliceous rock-matter.

No. 16. Magnetic ore from a very large deposit on lots 15 and 16, concession 8, township of Wollaston. The sample, subjected to analysis, consisted of surface specimens, slightly peroxidized. The deposit, under the name of the Coe Hill Mine has since been opened, and is now largely worked. On descending, a few pyritous streaks have been encountered, and here and there the ore is mixed with a somewhat larger amount of rock-matter, but this is pyroxenic, and hence comparatively self-fluxing, throughout the entire mass of the deposit. The average amount of iron is from 60 to 66 per cent. Titanium is entirely absent.

No. 17. A magnetic ore of high grade, from a very large deposit on lots 6, 7 and 8, concession 19, township of Tudor. The exposed ore rises in a series of ledges from the level of the ground to a height of from 150 to 180 feet, and extends over a space of at least 1000 feet in length by 100 feet in breadth. It is thus, in all probability, an enormous mass or "stock," the portion above ground alone including many thousand tons of ore. The ore, itself, is comparatively soft, and of a fine-granular, more or less porous, texture. The analysis shows 63.30 per cent. metal, with total absence of titanium, and traces only of phosphorus and sulphur. It is one of the finest ores in this section of Ontario. The intermixed rock-matter (8.36 per cent. in my samples) yielded: silica 5.22, lime 1.93, magnesia, etc., (by difference) 1.21. The deposit is known as the Emily Mine.

No. 18. A very superior magnetic ore from lot 18, concession 18, township of Tudor. The ore is exposed in the form of a broken curve or semicircle along the eastern face of a somewhat abrupt ridge or slope, over a length of about 1,200 feet, but it can be traced much beyond that distance. About 500 feet to the south of this exposure a large mass of similar ore, probably an extension of the main body, comes to the surface. Here and there a few specks and thin strings of pyrites are visible, but the ore on the whole is of more than average quality. In the sample taken for analysis the amount of metallic iron equalled 68·16 per cent. In other samples, subsequently examined, it averaged 66 per cent.[1]

[1] A recently published analysis of this ore, said to have been made in Pittsburg, puts the amount of metallic iron at only 61·504 per cent., with 8·130 silica, 0·060 phosphorus, and 0·056 sulphur; but this can scarcely be correct, as 61·504 iron corresponds to 85·05 magnetic oxide, and that amount, added to the other components, brings up the total to 93.296, thus showing a loss in the analysis of 6·70 per cent. It should also be pointed out that the insoluble rock-matter is not silica, as stated in the Pittsburg analysis, but essentially pyroxene. Free silica is in many respects an objectionable substance in an iron-ore; whereas the presence of a calcareo-magnesian silicate, such as pyroxene, is of far less moment.

The intermixed rock-matter is essentially pyroxenic, with very little free silica, and there is no trace of titanium in the ore. The deposit is known as the Baker or Horse-shoe Mine.

II.—Titaniferous Magnetites.

No. of Ore. See below.	Fe^3O^4.	TiO^2.	S.	P.	Siliceous Rock-matter.
1	71·22	25·51	0·43	tr.	5.13
2	71·87	13·30	0·06	0·005	15·28
3	83·36	8·08	0·08	0·007	9·31

No. 1. A black, granular, strongly magnetic ore, from lot 11, concession 1, township of Minden. Specific gravity, 4.336. Other samples, from lots 10, 12, 13 and 15 in the same concession, were found to contain large amounts of titanium, and also a good deal of intermixed micaceous rock-matter. All were taken from natural exposures and shallow trial-pits, indicating, apparently, stock-formed masses of considerable extent. In estimating the titanium, in the analysis of titaniferous ores, as TiO^2, an excess in the sum total of the analysis is always obtained ; but this disappears if the amount of TiO^2 be reduced by calculation to Ti^2O^3.

No. 2. A black, strongly magnetic ore, from an enormous deposit on lot 35, concession 4, township of Glamorgan, about half-a-mile south of Burnt River. The deposit rises abruptly in the form of a succession of ledges to a height of from 80 to 100 feet above the general level of the ground, and it is exposed in an easterly and westerly direction over a length of at least 1,800 feet, with an average width of 140 feet. It is evidently a stock-formed mass. (See Transactions Roy. Soc. Canada, 1884, page 159). The analyzed sample held 52·04 per cent. metallic iron, and 8·11 per cent. titanium. A small amount of $CaCO^3$ (=0·86 p. c.) was also found in the ore.

No. 3. This ore is very similar in character and conditions of occurrence to No. 2, although separated from the latter by a distance of at least twenty-five or thirty miles. It occurs in the township of Tudor, on lots 55-57 of the Free Grant District, where it is exposed along the face of a steep slope, and over a wide extent of ground. (See description in the Transactions Roy. Soc. Canada for 1884, page 160.) In order to test the depth of the deposit, and especially to settle the disputed point as to whether the presence of titanium, in ores of this kind, may not disappear in lower portions of the mass, the owners of the property have lately taken out some solid cores of ore by a diamond drill from a depth of 70 feet from the surface, without reaching the base of the deposit. A portion of one of these cores, examined by the writer, yielded 10·86 per cent. TiO^2. It may be concluded therefore, that in these titaniferous ores the titanium will be found to pervade the entire mass of the deposit. The amount in the present case was somewhat greater at this depth of 70 feet, than in samples taken from shallow depths, in consequence of a diminished percentage of rock-matter. The presence of these titaniferous masses in close proximity

to deposits in which no trace of titanium can be detected, is a fact of much interest, hitherto apparently unrecognized in the iron districts of Europe.

III.—Hematites.

No. of Ore. See below.	Fe^2O^3.	Mn^2O^3.	S.	P.	Siliceous Rock-matter.	$CaCO^3$.
1	91.60	0.19	0.400	0.017	6.04	2.12
2	99.07	tr.	tr.	tr.	0.89	"
3	97.18	"	"	0.030	2.78	"
4	76.53	"	"	0.022	13.43	10.08
5	70.64	"	"	tr.	17.22	12.10

No. 1. This ore, as regards its locality, lies just beyond the area to which the present communication is essentially confined. It occurs near the village of Tamworth, in Sheffield township, Addington County, where it has been mined to some extent; but the sample was sent to me for analysis, and I have no authentic information as to the conditions of occurrence and probable quantity of the ore. The sample consisted of red, semi-crystalline hematite of very good quality, holding 64·12 per cent. metallic iron.

No. 2. This is an exceedingly pure and rich hematite of a steel-grey colour, more or less compact structure, and dull-red streak, from lot 13, concession 10, township of Marmora, where it is known as the Bentlif ore. Small exposures shew over the west half of the lot generally, but the ground, as yet, is entirely undeveloped. Metallic iron, 69·35 per cent., with rock-matter (silica) under 1 per cent.

No. 3. Red iron ore from the Wallbridge Mine, lot 12, concession 5, township of Madoc. The sample was taken, some time ago, from near the central portion of the large "stock" or ore-mass of which the deposit consisted. As shewn by the analysis, the ore from the deposit generally was of exceedingly good quality, holding very little rock-matter, and an average of 60 to 66 per cent. metal. But the deposit, after yielding a very large amount of good ore, is nearly worked out; and the ore is passing into ferruginous rock around the entire limits of the deposit.[1]

Nos. 4 and 5. Samples of poor ore from the shaft and drift of the so-called Miller Mine, forming an extension, to the east, of the Wallbridge deposit. These samples, taken from a depth of about 60 feet from the surface, near the extreme easterly limit of the ore stock, shew conclusively the exhausted condition of the latter. At the Wallbridge Mine, proper, the ore has been taken out by open quarrying. The large excavation, which has thus resulted, averages 170 feet in length by 100 feet in breadth, with a depth of about 80 feet. An exhaustion, like that shewn by this mine, must necessarily follow, sooner or or later, the working of all stock-formed deposits, although many may hold out and yield a large supply of ore for years.

[1] The mine is now (October, 1885) entirely exhausted and abandoned. See a communication by the writer in the present volume of Transactions, Section IV.

IV.—*On the Density of Weak Aqueous Solutions of Certain Salts.*

By J. G. MACGREGOR, D.Sc.

(Presented May 28, 1885.)

The following experiments were made with two objects: (1) to determine whether or not there are solutions of the salts used, given volumes of which are less than the volumes at the same temperature of the water which they contain; and (2) to find how the density of very weak solutions varies with their strength.

Professor Ewing[1] and I had found, by two experimental methods, that sufficiently weak solutions of sulphate of copper contain amounts of water whose volumes if free would be greater than those of the solutions themselves; and that anhydrous copper sulphate, added in small quantities to water, produces solutions of smaller bulk than the original water. We had also[2] found that certain somewhat rough density-measurements had indicated the same peculiarity in the case of zinc sulphate. It seemed desirable therefore to subject this salt to careful experiments and to extend the investigation to other hydrated salts.

The data which we possess as to the variation of the density of solutions with their strength, do not generally extend to weaker solutions than those which contain 2 or 3 per cent. of salt, and are insufficient to settle the question. I have, therefore, made observations in the case of zinc sulphate and other salts, which both determine the question of the possession of the peculiarity referred to above, and supply a portion of what has hitherto been lacking in our knowledge of the phenomena of their solution.

My apparatus consisted of four dilatometers, which were large glass bottles (commonly called Winchester quarts), with glass tubes fitted in their necks. The bottles had capacities of about 2,600 c.c. The glass tubes were about 25 cm. in length and 0·4 sq. cm. in section, and were chosen so as to be as uniform in bore as possible. They were fitted to the bottles by means of India-rubber stoppers, and fitted so tightly that there could be no danger of any relative displacement of tube and bottle. The rubber stoppers were held fast to the bottle by wires. Their inner ends were hollowed conically, and the glass tubes started from the summits of the conical hollows, so that air bubbles could easily be made to pass up the tubes. At their upper ends the tubes widened into funnels. Fine scratches on the tubes served as zero marks. The bottles stood in a large zinc bath up to their necks in water. The dilatometers were calibrated by being filled with distilled water of known temperature, from measuring vessels whose volumes were known. The one used in calibrating the tubes was so divided that changes in the volume of the water it con-

[1] Trans. Roy. Soc. Edin., vol. xxvii. (1873) p. 51; Reports Brit. Asso. (1877); Trans. Roy. Soc. Canada, vol. ii. (1884) sec. iii. p 69.

[2] Trans. Roy. Soc. Edin., vol. xxvii. (1873) p. 51.

tained could be read to 0·05 c.c. The water, with which the bottles were thus filled, had been freed from air under the receiver of an air-pump.

To test the tightness of the stoppers, the dilatometers were filled, until the upper surfaces of the water were near the tops of the tubes. The stoppers were thus subjected to as great pressures as they would be during the experiments. After the bottles had taken the temperature of the bath, I observed the variation of the height of the water in the tubes from time to time, until I had satisfied myself that there was no leak,—a return to a formerly observed height in one bottle being accompanied in all cases by a similar return in the others.

I next satisfied myself that differences of temperature between the bottles, greater than any which could arise during the experiments through the dissolving of salt in some bottles and not in others, would vanish in less than the time that was to intervene between successive measurements.

As the dilatometers could not be kept at constant temperature, and as any change of volume of their contents must therefore be partially due to change of temperature, it was necessary to know the relative apparent thermal expansion of their contents. For this purpose, both at the outset when all the bottles contained water, and at intervals during the series of experiments when some of them contained solutions, the temperature of the bath was varied, and the heights of the water or solutions in the different tubes were observed when the bottles had assumed the temperature of the bath. These results were tabulated for purposes of correction.

The solutions, whose volumes were measured, were formed by the addition of known masses of anhydrous salt to the water in the bottles. The salt was simply dropped little by little down the tubes of the dilatometers. In some cases no difficulty was experienced; in others the salt was found to cake occasionally at the surface of the liquid. In these cases various expedients were adopted to hasten the solution; but the greatest care was taken to prevent the loss, either of any of the salt which had been weighed out for solution, or of any of the liquid in the bottles. When the desired amount of salt had been added to a bottle, the upper end of the tube was closed with a small cork to prevent evaporation, and the bottle was put in the bath. After an interval of about twenty-two hours the bottle was taken out, and if the salt was found to be dissolved, was first well corked and then rolled, until its contents had been thoroughly mixed. It was then replaced in the bath and left for another hour, when the height of the free surface of the liquid was observed. Not possessing a cathetometer, I required, for measuring differences of level, to trust to a steel scale placed in contact with the tube. Care was of course taken to avoid parallactic errors as much as possible.

To one of the four bottles no salt was added; and it was kept carefully corked up, so that the quantity of water it contained might be constant. The variation of the height of the water in the tube of this bottle was due, of course, to change of temperature alone. This variation being observed, and the relative apparent thermal expansions of the liquids in the four bottles being known from the subsidiary experiments referred to above, the variations, due to changes of temperature, of the heights of the solutions in the tubes of their respective bottles could be determined and eliminated. The variations of temperature were in all cases slight, the bath being large and its daily thermal history being very constant.

The salts which I used, zinc sulphate ($ZnSO_4$), magnesium sulphate ($MgSO_4$), and calcium chloride ($CaCl_2$) were bought as pure, repurified by crystallization, and dehydrated by careful heating to the necessary temperature.

In all cases, after the solutions had stood a while, a slight fluffy appearance presented itself in the bottles. The mass of the precipitated solid was, however, very small—so small that it was hardly possible to weight it. Hence I considered that its effect on the result might be neglected. It was probably due to the presence of some impurity in the water, perhaps of ammonia.

The following are the results of the experiments :—

Zinc Sulphate—$ZnSO_4$.

Volume of bottle to zero mark at 19°·5 C. = 2687 c.c.
Mass of water in bottle = 2683·1 grammes.
Mean section of tube = 0·40 sq. cm.

Mass of Salt added. (grammes.)	Mass of Salt per unit Mass of Water.	Mass of Salt per unit Mass of Solution.	Rise of Solution in tube, corrected for change of Temperature. (cm.)	Increment of Volume per unit of Initial Volume.	Density of Solution. (grm. per c.c.)
5	·00186	·00186	0·46	·0000685	1·00179
5	·00373	·00371	1·10	·0001638	1·00356
5	·00559	·00556	1·77	·0002635	1·00530
5	·00745	·00740	2·24	·0003335	1·00711
10	·01118	·01106	3·48	·0005181	1·01065
10	·01491	·01469	5·36	·0007979	1·01410
10	·01863	·01829	7·23	·0010763	1·01753
10	·02236	·02187	8·12	·0012089	1·02112
10	·02609	·02542	9·97	·0014842	1·02446
10	·02981	·02895	11·98	·0017834	1·02798

In the above table, the first and fourth columns contain the results of observation; the others are calculated from these. The third column shews the solutions examined to have been of strengths varying from 0·186 to 2·895 per cent. of salt in solution. The fourth and fifth columns shew that even the weakest solution formed has a volume greater than that of the water which it contains.

The former rough measurements, alluded to above, which seemed to shew that weak solutions of this salt had volumes less than the volumes of the water they contained, were made with solutions, the weakest of which was of about 2.5 per cent. strength. It appears therefore that zinc sulphate solutions do not exhibit this peculiarity.

The relation between the mass of salt per unit mass of solution and the density of weak solutions of this salt is shewn graphically in Plate I. The points determined by taking the former as abscissæ, the excess of the latter over unity as ordinates, are found to

lie very nearly on a straight line passing through the origin. For these solutions, therefore, the increase of density, due to the addition of anhydrous salt to water, is approximately simply proportional to the percentage of salt in the solution thus formed.

The agreement of the density of the strongest solution of the above table, with that of the same solution as determined by interpolation in the results of Gerlach[1] and of Schiff, is shewn by the following numbers :—

According to Schiff, density = 1·0289 at 20°·5 C.
" Gerlach, " = 1·0298 at 15°· C.
" above table, " = 1·0280 at 19°·5 C.

This is the only one of the above solutions with which Schiff's and Gerlach's results are comparable.

Magnesium Sulphate—$MgSO_4$.

Volume of bottle to zero mark at 9°·5 C = 2619·6 c.c.
Mass of water in bottle = 2618·9 grm.
Mean section of tube = 0·40 sq. cm.

Mass of Salt added. (grammes.)	Mass of Salt per unit Mass of Water.	Mass of Salt per unit Mass of Solution.	Rise of Solution in tube, (corrected for variation of Temperature.) (cm.)	Increment of Volume per unit of Initial Volume.	Density of Solution. (grm. per c.c.)
5	·00191	·00191	0·93	·0001420	1·00170
5	·00382	·00380	2·25	·0003436	1·00346
5	·00573	·00569	3·06	·0004672	1·00526
5	·00763	·00758	3·80	·0005802	1·00705
10	·01145	·01132	5·48	·0008368	1·01060

As in the former table, the first and fourth columns contain the experimental results. The strengths of the solutions examined varied from 0·191 to 1·132 per cent. of salt in solution. The fourth and fifth columns shew, that the volumes of all these solutions are greater than those of the water they contain. This salt therefore does not exhibit the same peculiarity as copper sulphate.

The relation between the concentration and the density of these solutions is shewn graphically in Plate I. The points, whose co-ordinates are the mass of salt per unit mass of solution and the excess of the density over unity respectively, lie very nearly on a straight line passing through the origin. For weak solutions of this salt, therefore, the increase of density is simply proportional to the percentage of salt in solution.

So far as I know, there are no existing observations with which any of the above may be compared. Those of Hassenfratz, Schiff, and Gerlach, were all made with solutions of greater strength.

[1] Gerlach : Fresenius' Zeitschrift, viii. (1869) 245.

Calcium Chloride—$CaCl_2$.

Volume of bottle to zero mark at 9°·5 = 2616·5 c.c.
Mass of water in bottle = 2615·8 grm.
Mean section of tube = 0·41 sq. cm.

Mass of Salt added. (grm.)	Mass of Salt per unit Mass of Water.	Mass of Salt per unit Mass of Solution.	Rise of Solution, in tube, (corrected for variation of Temperature.) (cm.)	Increment of Volume per unit of Initial Volume.	Density of Solution. (grm. per c.c.)
5	·00191	·00191	1·57	·0002478	1·00168
5	·00382	·00381	4·07	·0006426	1·00317
5	·00573	·00570	6·67	·0010528	1·00465
5	·00765	·00759	9·47	·0014948	1·00615
5	·00956	·00947	12·19	·0019241	1·00765
10	·01338	·01320	18·22	·0028759	1 01050

The direct experimental results are contained in the first and fourth columns. The strengths of the solutions examined varied from 0·191 to 1·32 per cent. of salt in solution, The fourth and fifth columns shew that, as in the case of the other two salts examined, all the solutions were more bulky than the constituent water.

The relation between the concentration and the density of these solutions is shewn graphically in Plate I, the mass of salt per unit mass of water being plotted against density. The result is a curve bending towards the axis of concentrations. In the case of this salt, therefore, the rate of change of density with concentration diminishes with the concentration.

I am not aware of the existence of any observations with which the above may be compared. Those of Schiff, Kremers, and Gerlach, were all made with solutions of greater strength.

V.—*On the Analysis of Silk.—Quantitative Estimation of Silk in a Mixed Texture.*

By DR. H. A. BAYNE, Royal Military College, Kingston.

(Read May 25, 1885.)

Silk is soluble in concentrated acids, both inorganic and organic, in alkaline solutions, and in certain other reagents, as basic zinc chloride, ammoniacal solution of oxide of copper or oxide of nickel, etc. It was my endeavour to ascertain to what extent these reagents also affect other fibre which may be woven in with silk, fraudulently or otherwise, and in this way to determine how the silk in a mixed texture may, with reliability, be ascertained quantitatively.

METHOD OF PROCEDURE.—Samples of pure silk, wool, cotton, and linen, were selected. Their purity was determined by the examination, under the microscope, of fibres taken from both warp and woof. The silk used in the greater portion of the analyses was the silk employed in the manufacture of cartridge bags for the British service, and warranted absolutely free from foreign fibre. This purity is requisite in this manufacture in order to prevent "smouldering" or "holding fire,"—a property belonging to other fibres, (particularly to cotten and linen), but from which silk is free.

Weighed samples of each variety of cloth were carefully dried at 100° C., and then treated with alcohol or ether and afterwards with dilute (1%) hydrochloric acid to remove any traces of greasy matter, weavers' dressing, or colouring matter in the fibre; then again dried at 100° C. and weighed, and subsequently all four samples submitted together to the action of the same reagent. After a second treatment with acidulated water or dilute alkaline solution and frequent washing, the samples were redried at 100° C. and the percentage of loss estimated.

SOLVENT ACTION OF ACIDS.—Concentrated nitric acid (cold) dissolves silk, but acts too energetically on other fibre also to afford a means of separation. The same may be said of concentrated chromic acid. Concentrated sulphuric acid seemed not so readily to dissolve silk and wool, while cotton and linen are converted into gummy substances soluble in water. Concentrated phosphoric acid (hot) dissolves silk, but also attacks wool and carbonizes cotton and linen. Very concentrated, boiling oxalic acid and tartaric acid solutions dissolve silk, but also act upon woollen fibre.

Melted oxalic, tartaric, and citric acids dissolve silk with great ease. The silk contracts rapidly to small bulk when put into melted oxalic acid and quickly dissolves. Unfortunately for this solvent of silk, which A. Lidow (*Journal der russischen physchem. Gesell.*, 1884, Vol. I. p. 280,) has proposed as a method of determining the proportion of silk in a mixed texture, the reagent also acts energetically upon wool; and cotton and linen, while not affected to the same extent, become disintegrated. Lidow intimates that wool is not attacked, and cellulose only very slightly attacked. This was not found to be sub-

stantiated by experiment. The result of several experiments with this reagent gave a loss of from 15 to 30% on the amount of wool, and from 2 to 3.5% on the vegetable fibre ployed.

Among concentrated acids, the only one yielding satisfactory results was found to be hydrochloric acid. Cold concentrated hydrochloric acid of 1.19 sp. gravity dissolved silk in from fifteen to twenty minutes, with a loss of woollen fibre amounting to only 0·83%. 1.12 acid acted likewise with a loss of 0·71% on wool, while cotton and linen were much more largely affected. This reagent may, therefore, be employed as a method of separating with considerable exactitude silk from wool but not from vegetable fibre.

Action of Alkaline Solutions.—Caustic potash and soda dissolve silk and also wool; even where these reagents are dilute. They also affect, when dilute, cotton and linen fibre to a small extent. Thus seven analyses with 4% caustic soda, heated to incipient boiling for from five to ten minutes, yielded the following average results:—

Silk and Wool completely dissolved.	
Cotton fibre, loss of	1.12%.
Linen, "	2.01%.

Special Reagents.

Ammoniacal Oxide of Nickel.—This reagent has been proposed as a solvent for silk by Schlossberger (*Annalen der Chemie and Pharmacie*, Vol. CVII. p. 21.) It was prepared for these analyses by precipitating the hydrated oxide of nickel by an alkali, separating the precipitate from the liquid, washing and dissolving in concentrated ammonia. This reagent dissolves silk at ordinary temperature in two to three hours, but also affects other fibres to a small extent. Wool becomes of a brown colour, removable by dilute hydrochloric acid. Cotton and linen seemed very little affected by this reagent.

Average of four analyses:—

Silk wholly dissolved.	
Wool, loss of	4.10%.
Cotton, "	0.55%.
Linen, "	0.52%.

Ammoniacal Oxide of Copper.—The so-called Schweizer reagent (*Dingler's Polytechniches Journal*, Vol. CXLVI. p. 361,) prepared by dissolving basic cupric sulphate in concentrated ammonia, dissolves silk readily, but also affects wool, cotton, and linen, though more slowly.

Two analyses in which the cloth was removed from the liquid immediately upon solution of the silk (about twenty minutes) yielded the following average results:—

Wool, loss of	2.86%.
Cotton, "	2.84%.
Linen. "	7.31%.

Alkaline Glycerine Solution of Oxide of Copper.—Loewe (*Dingler's Polytechniches Journal*, Vol. CCXXII. p. 274,) recommends for the preparation of this reagent the following proportions:—

Cupric Sulphate	16 grs. pure.
Distilled Water	140 to 160 c.c.
Glycerine	8 to 10 grs. of 1.24 density.

Caustic soda solution is added to this mixture drop by drop until the hydrated oxide of copper, at first precipitated, is again dissolved. Excess of caustic soda is especially to be avoided.

On placing the mixed fibres in the blue liquid thus obtained, it was found that the silk was completely dissolved in the course of from two to three hours at the ordinary temperature. The process may be hastened by stirring the liquid from time to time. The wool, under the action of the same reagent, became blackened, probably from the action of the sulphur of the wool on the copper of the solution. Cotton and linen merely acquired the blue colour of the solution. The colour in each case was easily removed on placing the wool, cotton and linen together for a few minutes in dilute hydrochloric acid, when the fibres acquired their natural colour. The same strength of acid was used as in the preliminary cleansing of the fibre so as to avoid any additional loss from this source. The residues were then carefully washed and dried at 100° C.

Average of six analyses :—

Silk, completely dissolved.	
Wool, loss of	3.48%.
Cotton, "	0.24%.
Linen, "	0.33%.

One sample set was allowed to remain for eighteen hours in the copper solution, and yielded the following results :—

Silk, completely dissolved.	
Wool, loss of	3.84%.
Cotton, "	0.22%.
Linen, "	0.34%.

It would seem that this reagent thus yields results which are quite reliable as a means of separation between silk and cotton or linen, while not so reliable as a quantitative method for a texture containing silk and wool.

Basic Zinc Chloride.—Persoz (*Moniteur scientifique*, Series 3, Vol. X. p. 336,) and Rémont more recently (*Chem. Zeit.*, 1881, No. 51, p. 972,) have advocated this reagent as a solvent for silk. It is prepared according to their directions by dissolving 100 grs. zinc chloride in 85 c.c. water, adding to the solution four grs. of zinc oxide, and heating until dissolved. In this reagent silk dissolves rapidly, (if hot, in one to two minutes); wool seems scarcely at all to be affected, while cotton and linen are both attacked, and more particularly so if the solution is not sufficiently basic. After treatment the residues were warmed with dilute hydrochloric acid, as in case of last-mentioned reagent, and boiled with water and dried at 100°.

Average of six analyses :—

Silk, completely dissolved.	
Wool, loss of	0.49%.
Cotton, "	1.74%.
Linen, "	3.67%.

As distinguished from the alkaline glycerine solution of oxide of copper, this reagent seems best adapted for the separation of silk from wool, while not so well adapted to the separation of silk from cotton or linen.

From the above analytical results it would thus seem that, for separations of a mixture of silk and wool, the use of cold concentrated hydrochloric acid or of basic zinc chloride yields the most reliable results; while for separation of silk from cotton or linen the ammoniacal oxide of nickel, and more particularly the alkaline glycerine solution of oxide of copper, yield thoroughly trustworthy indications. When the liability to loss of small portions of fibre incidental to analyses of this kind (in the various treatments and washings to which the cloth is submitted) is considered, the small percentage of loss on wool in the former reagents, and of cotton and linen in the latter, entitles the methods to be deemed of considerable exactitude.

The results of attempts at determining the amount of silk quantitatively by reprecipitation from any one of its solvents were unsatisfactory. While the fibroin is in part often precipitated, the serecine seems to be too readily soluble to be wholly precipitable. Lidow's statement that fibroin is wholly precipitable from its solution in melted oxalic acid by 96% alcohol, I do not find to be substantiated on experiment, nor that from its solution in tartaric, gallic, pyrogallic, citric acid it is wholly precipitable by tannic acid or saturated saline solutions. The precipitation of silk from solution in alkaline glycerine solution of oxide of copper and from other solvents by neutralization of the liquid, seemed only partial and not such as to afford a quantitative method.

VI.—*On a Natural System in Mineralogy; with a Classification of Native Silicates.*[1]

By T. STERRY HUNT, M.A., LL.D. (Cantab.), F.R.S.

(Read in abstract May 27, 1885.)

I.—*Historical Introduction.*—The natural-historical method in mineralogy; Werner and Mohs. The chemical method of Berzelius and his followers.

II.—*Attempt at a Natural System.*—The author's endeavours to establish such a system in mineralogy.

III.—*A Classification of Silicates.*—The genetic relations of their suborders and tribes; discussion of genera and species of Silicates, with tables. Oxydates and Metallates; a mineralogical system. The question of molecular weights. Synoptical tables of Silicates.

I.—HISTORICAL INTRODUCTION.

§ 1. The examination of the various species of the inorganic kingdom which constitute the crust of the earth has long occupied the attention of students of natural history, and has given rise to descriptive and systematic mineralogy. Botanists and zoologists, by making known the structure, growth and development of organic species, have meanwhile performed a similar task for the vegetable and animal kingdoms, and have moreover arranged organic species in genera, families, orders and classes, in such manner as to shew more or less perfectly their origin and affinities, so that to-day the received classifications of plants and animals merit the name of natural systems.

§ 2. Without adverting to the work of earlier students, it should be said that Werner, about a century since, proposed for the mineral kingdom a classification which makes an epoch in the history of mineralogy. His system was based on "the natural alliances and differences which exist between minerals," and of him it is said that he "established and arranged the greater number of species in the mineral kingdom solely by agreements and differences in external characters," grouping the various minerals in classes, families, genera, species, sub-species and kinds. While chemical considerations were not overlooked in the larger divisions, Werner, according to Jameson, regarded the intervention of chemistry as but a provisional expedient, and doubted the possibility of constructing a philosophical system in which the external and the chemical characters should be conjoined.

§ 3. Werner died in 1817, and was succeeded at Freiberg by Frederick Mohs, who sought to complete the work of his great predecessor in mineralogy. His early publications on mineral classification go back to 1805, but it was not till 1822–24 that he gave to the world his "Grundriss der Mineralogie" in two volumes. This was translated into

[1] An abstract of this paper was previously presented to the National Academy of Sciences at Washington, April 23, 1885, and is published in the American Naturalist for July, and also, with some further explanations, in the Canadian Record of Science, i. 129–135, 244–247.

English, with additions, by one afterwards famous in science, William Haidinger, who declared in the preface to that translation, published in Edinburgh in 1825, that he had been a student in mineralogy with Mohs since 1812.

Previous to 1820, however, Mohs had visited Edinburgh, and had there aided Jameson, then preparing the third edition of his "System of Mineralogy," which appeared in three volumes in Edinburgh in 1820. In his preface to this edition, Jameson gratefully acknowledges his aid, and says that the arrangement adopted "is nearly that of my celebrated friend, Mohs, who now fills the mineralogical chair of the illustrious Werner." He adds, "the mineral system, as it appears in this work, is to be considered as realizing those views which Werner entertained in regard to the mode of arranging and determining minerals." This system, which was designated by Jameson, the Natural History Method, is, according to him, "founded on what are popularly called external characters, and is totally independent of any aid from chemistry." It was, moreover, in his opinion, the only method "by which minerals would be scientifically arranged and rightly determined."[1]

§ 4. The system of Mohs at once found favour with naturalists and was adopted by many (notably by his successor Breithaupt,) not, however, without certain modifications as to the divisions, some of which may here be noticed in order to give a general idea of the plan of classification. In the order SPAR, as defined by Mohs, were included, not only all zeolites, scapolites and feldspars, with sodalite, nephelite and leucite, but petalite, spodumene and cyanite, as well as pyroxene, amphibole, wollastonite and epidote; the latter four being made species of one genus, *Augite-Spar.* Again, in the order GEM of Mohs we find garnet, idocrase and staurolite grouped together as species of the genus *Garnet;* chrysolite, axinite, emerald, tourmaline, topaz, andalusite and zircon, types of as many genera; together with the genus *Quartz*, including the species, iolite, quartz and opal. Corundum, chrysoberyl and spinel are also united in one genus, and boracite and diamond constitute other genera under this order.

§ 5. In adopting the system of Mohs, Charles Upham Shepard subdivided the order SPAR, and established a new order, ZEOLITE, in which were included with the zeolites, sodalite, nepheline and leucite; the other genera in the order SPAR of Mohs being left as before. J. D. Dana, on the contrary, enlarged this order, renamed by him CHALCINEA, by adding to it a large part of the order MICA of Mohs, including all the true micas then known. He, on the other hand, removed epidote from the alliance with pyroxene made by Mohs, and placed it in its proper position with garnet and idocrase in the order GEM, called by Dana, HYALINEA. This, for the rest, embraced all the species which had been therein included by Mohs, whom Dana followed by placing cyanite and fibrolite with the Spars, while andalusite was arranged with the Gems.

§ 6. Bearing in mind the changes just noted, we have to record that in 1835 the classification and the nomenclature of Mohs, as translated into English by Haidinger, were adopted by Shepard, in the first edition of his "Treatise on Mineralogy." In the second

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[1] For a further notice of Werner's views of mineral classification, the reader is referred to the preface to Jameson's work, already cited, and also to Cleveland's Treatise on Mineralogy and Geology, in 1822, where, in Vol. i. pp. 77—83, will be found an excellent analysis of Werner's mineralogical system as put forth by him at Freiberg in 1816.

and third editions of this work, however, in 1844 and 1852, Shepard, while retaining with slight modifications the classes and orders of Mohs, abandoned the characteristic specific names of the latter for the trivial names generally accepted. The natural-history system of Mohs was also adopted in the first and second editions of his "System of Mineralogy," by J. D. Dana, in 1837 and 1844. He, however, devised a Latin terminology for the orders, as well as a binomial Latin nomenclature for the genera and species.

§ 7. In abandoning the natural-history system in his third edition, in 1850, Dana returned to the trivial nomenclature. Referring to these changes, its author declared in the preface to a fourth edition of his System, in 1854, his opinion that "the system of Mohs, valuable in its day, had subserved its end, and that in throwing off its shackles for the more consistent principles flowing from recent views on chemistry, the many difficulties in the way of perfecting a new classification led the author to an arrangement which should serve the convenience of the student, without pretending to strict science."

A so-called "purely chemical mineral system" had been proposed by Berzelius as early as 1815,[1] and had meanwhile found favour with chemists. Towards this, the difficulties of the natural-history method in mineralogy directed Dana, who, in the preface to his second edition, in 1844, gave "besides the natural classification, another placing the minerals under the principal element in their composition;" adding that "various improvements on the usual chemical methods have been introduced, which may render it acceptable to those who prefer that mode of arrangement." The chemical scheme then given by him was, as he informs us, taken almost entirely from Rammelsberg's treatise on Chemical Mineralogy, then recently published. In 1850, in the latter part of his third edition, Dana put forth a new chemical classification "in which the Berzelian method was coupled with crystallography;" while in his fourth edition, in 1854, he maintained that "the classification of minerals must flow directly from the principles of chemistry," and accepted what he now called the Berzelian System, which, as his readers are aware, is retained in his fifth and last edition, that of 1868.

§ 8. The views of Berzelius, as adopted and modified by Rammelsberg, Naumann, Dana and others, now prevail among students of mineralogy, with whom the results of the chemical analysis of species are generally considered as of paramount significance; while hardness, specific gravity, crystalline form, and optical characters assume a secondary value in classification, and are regarded as important chiefly in connection with determinative mineralogy. The conception of a true natural method which, although but partially understood, was at the basis of the system of Mohs, has been lost sight of; the order which the naturalist finds in the organic is no longer apparent in the inorganic world, as presented in modern mineralogical text-books; and this state of things has contributed not a little to the comparative neglect into which systematic mineralogy has of late years fallen.

As to the complete divorce between physical and chemical characters in the study of mineral species, maintained by Werner, Mohs and his followers, there seems to have underlaid it the notion of framing a system which, as in botany and zoology, shall be available for the purposes of determination without the destruction of the individual. It is to be noted however, that characters dependent upon chemical differences, such as

[1] Berzelius, Nouveau Système de Mineralogie, Paris, 1819.

the presence or absence of certain acids, alkaloids and groups of essential oils, are not without significance in determining the natural affinities of plants, and, moreover, that as we descend the scale of being, from the highly organized forms of the animal and vegetable world to the simple crystal or the amorphous colloid mass, the external characters which serve to show likeness and difference become fewer, and are often obscure and ill-defined. Again, a natural system is not one subordinate to the end of identifying species, but should consider objects in all their alliances and relations. Such a system, as long since defined by John Ray, is one which neither brings together dissimilar species nor separates those which are nearly allied, and the most important resemblances and differences in the mineral kingdom are in many cases those which can only be determined by chemical investigation.

§ 9. If, however, we regard as mistaken those who in their search after a natural system in mineralogy have rejected the aid of chemistry, it must be said, on the other hand, that the chemical mineralogists who, disregarding the relations of density and hardness or relegating them to a secondary rank, build systems on the results of chemical analysis, are false to chemical science itself. There exist, in fact, inherent and necessary relations between the physical characters and the chemical constitution of inorganic bodies which serve to unite and reconcile the natural-historical and the chemical methods in mineralogy. A physico-chemical study of the mineral kingdom, having in view these relations, will enable us, while remaining faithful to the great traditions of Werner and of Mohs, to frame a classification which it is believed will merit the title of a Natural System in Mineralogy.

II.—An Attempt at a Natural System.

§ 10. That such a system is possible was maintained by the present writer in a series of papers published in 1853, 1854 and 1855, to be noticed in detail further on. In putting forth, in the first named year, my conclusions as to the extension of chemical homology, and the similarity of volume in isomorphous species, it was said that "these views will be found to enlarge and simplify the plan of chemical science, and lead to a correct mineralogical system." This aim was again clearly defined in a communication to the French Academy of Sciences in 1863, published in the *Compte Rendu* and also, in a translation by the author, in the *American Journal of Science*, in the same year.[1] Therein, while adverting to an earlier note on the same subject, which appeared in the *Compte Rendu* for July 9th, 1855, it was said that the views of polymerism in mineral species and of the connection between relative condensation or specific gravity, hardness, and chemical characters are "as I have already elsewhere shown, of great importance in mineralogy, and will form the basis of a new system of classification which will be at the same time chemical and natural-historical." These early papers however, perhaps from the general and abstract manner in which the subjects were then treated, have hitherto received but little attention either from chemists or from mineralogists.

§ 11. The whole subject was again discussed in 1867 in an essay entitled "The Objects and Method of Mineralogy," in which the argument of the preceding papers was resumed.

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[1] Compte Rendu de l'Acad., June 29, 1863, and Amer. Jour. Science, xxxvi. 426–428.

It was therein maintained that chemistry is to mineralogy what biotics is to organography; that both physics (or dynamics) and chemistry, which together preside over the genesis of inorganic species, must be taken into account in their study, and that chemical characters must be greatly depended upon in mineralogical classification; while it was added that "in its wider sense the chemical history of bodies takes into consideration all those characters" upon which the natural-history system is based.[1]

§ 12. After discussing in this connection the question of the densities of certain substances of high equivalent, alike in vapor and in liquid and solid forms, it was said: "Starting from these high equivalent weights of liquid and solid hydrocarbonaceous species, and their correspondingly complex formulas, we are prepared to admit that other orders of mineral species, such as oxyds, silicates, carbonates, and sulphids, have formulas and equivalent weights corresponding to their still higher densities; and we proceed to apply to these bodies the laws of substitution, homology, and polymerism, which have so long been recognized in the chemical study of the members of the hydrocarbon series. The formulas thus deduced for the native silicates and carbon-spars shew that these polybasic salts may contain many atoms of different bases, and their frequently complex and varying constitution is thus rendered intelligible. In the application of the principle of chemical homology we find a ready and natural explanation of those variations within certain limits, occasionally met with in the composition of certain crystalline silicates, sulphids, etc.; from which some have conjectured the existence of a deviation from the law of definite proportions in what is only an expression of that law in a higher form. The principle of polymerism is exemplified in related mineral species, such as meionite and zoisite, dipyre and jadeite, hornblende and pyroxene, calcite and aragonite, opal and quartz, in the zircons of different densities, and in the various forms of titanic acid and of carbon, whose relations become at once intelligible if we adopt for these species high equivalent weights and complex molecules. The hardness of these isomeric or allotropic species, and their indifference to chemical reagents, increase with their condensation or, in other words, vary inversely as their empirical equivalent volumes; so that we here find a direct relation between chemical and physical properties. . . . ."

§ 13. "Chemical change implies disorganization, and all so-called chemical species are inorganic, that is to say, unorganized, and hence really belong to the mineral kingdom. In this extended sense, mineralogy takes in not only the few metals, oxyds, sulphids, silicates, and other salts which are found in nature, but also all those which are the products of the chemist's skill. It embraces not only the few native resins and hydrocarbons, but all the bodies of the carbon series made known by the researches of modern chemistry. The primary object of a natural classification, it must be remembered, is not, like that of an artificial system, to serve the purpose of determining species, or the convenience of the student; but so to arrange bodies in orders, genera, and species, as to satisfy most thoroughly natural affinities. Such a classification in mineralogy will be based upon a consideration of all the physical and chemical relations of bodies, and will enable us to see that the various properties of a species are not so many arbitrary signs, but the necessary results of its constitution. It will give for the mineral kingdom what the

[1] Read before the American Academy of Sciences, Jan., 1867, and published in the Amer. Jour. Science of the same year, xliii. 203–206: also in the author's Chemical and Geological Essays, pp. 453–458.

labours of great naturalists have already nearly attained for the vegetable and animal kingdoms."

§ 14. "In approaching this great problem of classification, we have to examine, first, the physical conditions and relations of each species, considered with relation to gravity, cohesion, light, heat, electricity, and magnetism; secondly, the chemical history of the species, in which are to be considered its nature as elemental or compound, its chemical relations to other species, and these relations as modified by physical conditions and forces. The quantitative relation of one mineral (chemical) species to another is its equivalent weight, and the chemical species, until it attains to individuality in the crystal, is essentially quantitative. It is from all the above data, which would include the whole physical and chemical history of inorganic bodies, that a natural system of mineralogical classification is to be built up. . . . The variable relations to space of the empirical equivalents of non-gaseous species or, in other words, the varying equivalent volume (obtained by dividing their empirical equivalent weights by the specific gravity), shows that there exist in different species very unlike degrees of condensation. At the same time, we are led to the conclusion that the molecular constitution of gems, spars, and ores, is such that those bodies must be represented by formulas not less complex, and with equivalent weights far more elevated than those usually assigned to the polycyanids, the alkaloids, and the proximate principles of plants. To similar conclusions conduce also the researches on the specific heat of compounds." In the paper, published in 1867, from which the above extracts are taken, it was further said that the views there set forth as "the basis of a true mineralogical classification" were not new, but had been brought forward and maintained by the author in various publications from 1853.

§ 15. The starting point in this inquiry was the study of the chemistry of carbon. It was in 1852 that I wrote, "we may define organic chemistry as the chemistry of the compounds of carbon,"[1] a statement which though a common-place to-day was then perhaps made for the first time. I then insisted upon what I called "the carbon series" and "the silicon series," the latter including all known silicon compounds. This was followed in 1853 by an essay on "The Theory of Chemical Changes and Equivalent Volumes,"[2] wherein the question of equivalent or so-called atomic volumes was discussed with relation to the investigations of Playfair and Joule, and the speculations of Dana. It was then and there suggested that "all species crystallizing in the same shape have the same equivalent volume, so that their equivalent weights (as in the case of vapors) are directly as their densites, and the equivalents of mineral species are as much more elevated than those of the carbon series as the specific gravities are higher."

§ 16. Another principle there set forth was the general application of the law of progressive or homologous series, first enunciated in 1842 by James Schiel of St. Louis, and soon afterwards adopted by Ch. Gerhardt, but hitherto applied only to hydrocarbonacous or so-called organic species. It was now said that "it may be expected that mineral

[1] Essay on Organic Chemistry, forming Part iv of the Principles of Chemistry by B. Silliman; 3rd revised edition, 1852, p. 378.

[2] Amer. Jour. Science, March, 1853 (xv. 226-234) L. E. & D. Philos. Mag., (4) v. 526, and in German in the Chemisches Centralblatt of Leipsic for the same year (p. 849); also in the author's Chem. and Geol. Essays, pp. 427-437.

species will exhibit the same relations as those of the carbon series, and the principle of homology be greatly extended in its application. The history of mineral species affords many instances of isomorphous silicates whose formulas differ by nO_2M_2, as the tourmalines, and the silicates of alumina and magnesia, while the latter, with many zeolites, exhibit a similar difference of nO_2H_2 [O in these formulas = 8]. The relation is in fact that which exists between neutral, surbasic and hydrated salts." It was further declared that the carbon-spars must be represented as polycarbonates, having not less than from "twelve to eighteen equivalents of base replaceable so as to give rise to a great number of species;" while the variations in the calculated atomic volumes of these carbonates were said to "indicate the existence of several homologous genera, which are isomorphous."

§ 17. These conceptions of progressive series of more or less highly condensed molecules of polycarbonates and polysilicates, and of similarity of volume for isomorphous species, were developed more at length in a second paper published in the same year, 1853, on "The Constitution and Equivalent Volume of Mineral Species."[1] It was therein explained that the formulas of homologous bodies may be represented as series in arithmetical progression, in which the first term may be like or unlike the common difference; both cases being, it was shown, illustrated in the chemical history of mineral species, including carbonates, silicates and oxyds. Similar views were also then extended to nitrates and sulphates, as well as to chlorids and to sulphids.

The simplest atomic formula of the carbonates being CMO_3 ($C = 6$ and $O = 8$, according to the equivalent weights then in use), the rhombohedral carbon-spars were referred to three genera represented by $n(CMO_3)$: namely, (1) calcite, $n = 30$; (2) dolomite, siderite and diallogite, $n = 36$; and (3) smithsonite and magnesite, $n = 40$. For the prismatic species, aragonite, like calcite, belonged to a genus with $n = 30$; while for strontianite, cerusite and bromlite, $n = 25$; and for witherite, $n = 22$. The volumes of the rhombohedral species deduced from these equivalents were from 550 to 560, and for the prismatic species from 500 to 510. These arbitrary weights and volumes were at the time supported by comparisons with those deduced from the formulas of the rhombohedral red-silver ores and the prismatic bournonite, and farther by the volume of the compound of glucose and sodium-chlorid, regarded as homœomorphous with calcite, with a density of 1.563, which, doubling its empirical formula, gave a volume of 558.5. The various alums, if their formulas be doubled, give in like manner, as was shown, volumes of from 543 to 561.

§ 18. Extending to the silicates the same notion of polymerism which had just been applied to the carbonates, the existence of various polysilicates was admitted. Thus the formulas of spodumene, diopside, hudsonite, and wollastonite, were described as presenting a homologous series of the first kind, in which the first term is the same as the common difference, "represented by $n(Si_2MO_3)$, the respective values of n being 30, 26, 24 and 22." Spodumene was then, chiefly on crystallographic grounds, compared with the pyroxenes. The excess of silica above the bisilicate ratio, met with in some amphiboles, was referred to as an example of a homology of the the second kind, in which the common difference is unlike the first term. To these species there was assigned an equivalent volume approximating to 460. In support of this volume, it was noted that

[1] Amer. Jour. Science, 1853 (xvi. 203-218) and in abstract in the author's Chem. and Geol. Essays, p. 438, etc.

the various orthophosphates and ortharseniates of sodium with $12H_2O$, have, according to Playfair and Joule, equivalent volumes of from 233 to 235, while ferrocyanid of potassium gives 230, lactose 234, and piperine (with a density of 1.244) 476, or about double these numbers. Other species, as it was pointed out, have apparently an equivalent volume of 430, and still others about 200, or some multiple of this number. Whether the weights thus assigned to various silicates and carbon-spars might represent their chemical equivalents or some portion thereof, they, in any case, served to show the relative condensation of matter in the different species compared.

§ 19. This subject was continued a few months later in a paper read at Washington in May, 1854, before the American Association for the Advancement of Science, entitled "Illustrations of Chemical Homology."[1] Therein were reviewed and reaffirmed the teachings of the two papers of 1853, while the principles of homology were farther exemplified, and it was maintained that homologies may exist alike between species differing by $n(M_2O_2)$ and $n(H_2O_2)$, and even between those related species which differ in the proportion of silica, so that the ratio between silica and bases has but a specific value. It was further contended that the water contained in a great many hydrated species often described as altered silicates, was to be regarded as not of subsequent introduction but an original and essential element of the species, as is admitted to be the case in the zeolites.

§ 20. In the second paper for 1853 was considered the question of chemical notation and formulas, which was farther illustrated in the paper of 1854. At this time the question of the atomicities of the elements had not yet been discussed, and the distinction between univalent and bivalent metals, suggested by Cannizaro in 1858, was unrecognized. The symbols then used for both of these stood for one atom, or for the proportion which in the so-called protoxyds is united with eight parts by weight of oxygen. In sesquioxyds, like alumina, however, recognizing the trivalent character of Al_2O_3 (27+24), it was by the writer regarded as corresponding to three atoms of oxyd of aluminicum = 3alO. Silica, which, following Berzelius, was then generally written SiO_3 (21+24) became 3siO. With this notation were constructed atomic formulas, the elements now regarded as diatomic being confounded with monatomic elements, and, like these, represented by capital letters. Thus the common atomic formula for bisilicates, as given above, was written $n(si_2MO_3)$ and spodumene, $n = 30$, was made $si_{60}O_{60}(al_{24}Li_4Na_2)O_{30}$. Similar atomic formulas are still employed in these pages, using, however, small letters to represent an atom of any element, whether univalent, like sodium or chlorine; bivalent, like calcium or oxygen; trivalent, like boron; quadrivalent, like silicon, titanium and carbon; or sexvalent, like the double molecule of aluminum. The above general formula is thus now written $n(si_2m_1o_3)$, and that given for spodumene $(si_{60}al_{24}li_4na_2)o_{90}$. In order to distinguish the atom of ferrosum = $\frac{1}{2}$Fe, from that of ferricum = $\frac{1}{3}$Fe, the former is written fe, and the latter fi, while manganicum, corresponding to manganic sesquioxyd, is mni.

§ 21. The M in the general formula M_2O_2, employed in 1853, was thus made to represent an atom either of protoxyd or sesquioxyd, and in 1854 a farther generalization was attempted. The boric, titanic, tantalic and niobic anhydrids were reduced to the same atomic formula as silica, and moreover, in view of the variations in the silica-ratio in

[1] Proc. Amer. Assoc. Adv. Science, 1854, pp. 237—247; also in abstract Amer. Jour. Science for Sept. of the same year, and noticed, with extracts, in the author's Chem. and Geol. Essays, p. 438, *et seq.*

related silicates, like feldspars, scapolites and micas, and the supposed replacement of silica by alumina in certain amphiboles, it was suggested that the old distinction of acid and base, recognized in the dualistic hypothesis, might be set aside. M, in the generalized formula as then written, $n(\mathrm{M\,O_2})$, would then represent not only Na and Ca, but al, si, bo, ti, and ta, as well, and "to this type, which is also that of the spinels, all silicates may be referred, except a certain number which, like eudialyte, sodalite and pyrosmalite, contain metallic chlorids, hauÿne, nosite and lapis-lazuli, which contain sulphates, and cancrinite, which holds a portion of carbonate. These are respectively basic chlorids, sulphates and carbonates, and are represented by $(\mathrm{M_2O_2})n.\ \mathrm{MCl}$; $(\mathrm{M_2O_2})n.\ \mathrm{S_2M_2O_8}$," etc. To these should, of course, be added the basic fluorids or oxyfluorids like chondrodite and topaz; and oxysulphids like helvite and danalite. It was then said "The above formulas are intended to involve no hypothesis as to the arrangement of the elements, for in the author's view, each species is an individual in which the pre-existence of different species that may be obtained by its decomposition cannot be asserted." The importance of this notation, proposed in 1854, will be apparent when we come to consider further the question of atomic volume in its relation to mineralogical classification.

§ 22. Another and an important question connected with the complex constitution which had been assumed for silicates and carbonates was considered in the paper now under review. The high molecular weight assigned to the polysilicates admitted the presence therein of many atoms of base, and of partial replacements; while the existence in crystalline species of visible mixtures of foreign matters also served to explain the presence of small portions of many elements detected therein by chemical analysis. It had, however, become apparent that there are variations in composition which can scarcely be explained in either of these ways. Delesse had already noticed that in the homœomorphous anisometric feldspars the silica-ratio varies continuously between albite and anorthite, and was disposed to regard the feldspars intermediate in composition between these two as varieties only.[1] Scheerer, also, had in like manner expressed the opinion that the various feldspars were to be regarded as combinations of anorthite with labradorite, albite or orthoclase, or of labradorite with albite. Von Waltershausen had however given a more definite shape to the notion already in the minds of chemists, when, in 1853, he proposed to admit three typical triclinic feldspars, anorthite, albite and krablite; the latter a supposed highly siliceous species with the atomic ratios, 1 : 3 : 24, since generally regarded as a mixture of albite with quartz. These three feldspars, according to him, "alone have the right to be regarded as species in mineralogy. . . . All other feldspars, labradorite, andesine, oligoclase, etc., are merely mixtures of these," and were conceived by him to be built up "of infinitely small crystals of anorthite and krablite, or of anorthite and albite."[2]

§ 23. At the time of writing, in 1854, I was ignorant of the lately published conclusions of Von Waltershausen. I had then made an extended series of analyses of these feldspars from the Norian rocks, and rejecting the hypothesis of Scheerer, to which I referred, attempted to give the matter a more definite form by pointing out that anorthite and albite might be represented by a common formula, which, if a molecular

[1] Delesse, Ann. des Mines, 1853 (5) iii. 376. Scheerer, Pogg. Ann. lxxxix. 19, cited in L. and K. Jahresbericht for 1853, p. 105.

[2] Sartorius von Waltershausen, Ueber die Vulkanischen Gesteine in Sicilien und Island, Gottingen, 1853. For this reference, and for other notes on the literature of this question I am indebted to my friend, Dr. G. F. Becker.

volume of about 402 were assigned, would be $32(M_2O_2)$, the two polysilicates being respectively, in the atomic notation adopted; $(si_{32}al_{24}Ca_8)O_{64}$ and $(si_{48}al_{12}Na_4)O_{64}$. Petalite having the volume of these, and its composition not being then definitely settled, was referred to the same general formula, while orthoclase, from its less density, was conjectured to be $30(M_2O_2)$. As regards the homœomorphous triclinic feldspars it was then said that "between anorthite and albite may be placed vosgite, labradorite, andesine, and oligoclase, whose composition and densities are such that they all enter into the same general formula with them, and have the same equivalent volume. The results of their analyses are by no means constant, and it is probable that many, if not all of them may be variable mixtures of albite and anorthite. Such crystalline mixtures are very common; thus in the alums, aluminium, iron and chromium, and potassium and ammonium, may replace one another in indefinite proportions. . . . Heintz has shown by fractional precipitation that there are mixtures of homologous fatty acids, which cannot be separated by crystallization, and have hitherto been regarded as distinct acids. The author insists that the possibility of such mixtures of related species should be constantly kept in view in the study of mineral chemistry. The small portions of lime and potash in many albites, and of soda in anorthite, petalite, and orthoclase, are to be ascribed to mixtures of other feldspar-species."

§ 24. These conclusions were reiterated in 1855, in a paper giving the results of my chemical studies of these feldspars (when Scheerer's hypothesis was noticed), and it was said that similar views "must also be extended to the scapolites."[1] Some years later, in 1864, Tschermak[2] put forth a view similar to that advocated by Von Waltershausen and myself, and maintained that the feldspars proper were reducible to three species, adularia or orthoclase, albite and anorthite. While recognizing the fact that certain potash-soda feldspars (such as perthite) are made up of alternations of orthoclase and albite, he further concluded, as I had already done, "that oligoclase, andesine and labradorite appear to be members of a great series with many transitional forms, and may be regarded as isomorphous mixtures of albite with anorthite, sometimes with small admixtures of orthoclase."

§ 25. With regard to this conception of the nature of these intermediate feldspars, it should be noted that the chemical difficulties in the way of verifying it are much greater than in the case of soluble compounds, where, as in the case of the fatty acids just mentioned, solution and separation by fractional precipitation are possible, or where differences in volatility may be appealed to. While a definite feldspar-species having the composition assigned to labradorite doubtless exists in nature, it is, nevertheless, true that a mixture of proportions of anorthite and albite containing equal parts of alumina, would give a centesimal composition identical with that assigned to labradorite, just as the composition of a fatty acid may be simulated by a mixture of its higher and lower homologues. In so far as the view of Von Waltershausen and myself, since adopted by Tschermak, is true, the action of acids capable of attacking the basic feldspars will enable us to discriminate between admixtures and definite intermediate species. That the latter should occur in nature is, *a priori*, probable from the composition of the parallel series of the

[1] Examinations of some Feldspathic Rocks; L. E. & D. Philos. Mag., May, 1855.

[2] Tschermak, 1864, K. K. Academie Wissenschaft, Wien, and Pogg. Ann. 1865, v. 139. See also the author's Chem. and Geol. Essays, p. 444.

zeolites, in which appear well crystallized species, having the atomic ratios (excluding the water) of the intermediate feldspars, and also from the evidences of species like hyalophane and leucite. The late observations by Tschermak as to the action of acids on various intermediate scapolites, to be noticed further on (§ 75), go far to show that these are not admixtures but integral compounds.

§ 26. In concluding the paper of 1854, which I have here reviewed, it was said with reference to the problem of a natural system in mineralogy, then, as now, before the writer :—

"No mineralogical classification can be complete which does not take into account both the chemical and the physical characters of species; and the connection between these, which is shown in the relation of equivalent weight to specific gravity, must constitute an important element in a natural system. Guided by their physical characters and composition, we bring together such homœomorphous species as belong to one chemical sub-type, and from the densities fix their formulas and comparative equivalent weights. From the comparison of the formulas and the associations of these different minerals, we must also decide which are to be considered as mixtures and which are true species. Until we shall have determined with certainty the comparative volumes of dissimilar crystalline forms, the relations of species differing in this respect must be decided by their affinities, and their places in a homologous series must remain undetermined. In this way we may hope to arrive at a mineralogical classification which shall satisfy alike the chemist and the naturalist."

§ 27. Before going farther, it seems proper to advert to the history of the notion of polymerism in silicates and carbonates, which enters into the views maintained in the author's papers of 1853 and 1854; and to show its relation to the views previously put forward by Auguste Laurent. He had already in 1847 proposed to reduce all natural silicates to a small number of types corresponding to the observed atomic ratios. These yield both neutral and basic salts, according to Laurent, who, moreover, in his notation admitted, in order to explain the complex results of chemical analysis, a divisibility of molecules to which he assigned no limit, and supposed that protoxyds and sesquioxyds might within certain limits replace each other indefinitely. He also extended a similar to the borates.[1] In a subsequent memoir, in 1849, Laurent criticised the arbitrary formulas proposed by chemical mineralogists, and showed that the relations therein set forth were often but approximations. It was pointed out by him that in many related species, as for example in the various micas, the atomic relations between sesquioxyds and protoxyds were not constant, and it was argued that these two classes of bases, and water, were capable of replacing each other mutually within certain limits, in ratios which, as represented by him in atomic formulas, seemed to be indefinite. He also insisted on the importance in silicates of small portions of water, which, though generally neglected in the formulas, ought not to be regarded as accidental. This later paper[2] however, while reflecting the perplexed state of chemical mineralogy, fails to propose any solution of the difficulties. The reader will note the broad distinction between the simple formulas with

[1] Comptes Rendus des Trav. de Chimie, July, 1847, from Comptes Rendus de l'Acad. xxiii. 1050, and xxiv. 94. For an analysis of Laurent's memoir by the writer, see Amer. Jour. Science, 1848, v. 405.

Sur les Silicates ; Comptes Rendus des Trav. de Chimie, 1849, pp. 256-288.

an indefinite divisibility of molecules, adopted by Laurent, and the complex formulas, necessarily including many atoms of base, employed by the writer, further supplemented by the conception of crystalline admixtures of homœomorphous species.

§ 28. It was not until 1860 that the doctrines of high equivalents and the existence of polycarbonates and polysilicates, maintained by the writer in 1852 and 1853, found an advocate; when Ad. Wurtz again put forth the notion of polysilicates, explaining their genesis from the union of several molecules of silicic hydrate and the successive elimination of water. He cited in this connection the example of the metastannates of Frémy, which contain five quadrivalent molecules of tin. Wurtz did not, however, attempt in any way to discuss the difficulties presented by the composition of the native polysilicates (for certain of which he proposed structural formulas), or to fix their equivalents, and he seems to have overlooked the earlier contributions to the subject by the present writer.[1]

§ 29. In 1859, in a paper on "Euphotide and Saussurite,"[2] the writer having made an extended chemical and mineralogical study of the typical saussurite, as found in the euphotide of Monte Rosa, in Switzerland, showed that it was not a feldspar, as generally supposed, but a finely granular or compact silicate, having the hardness of quartz, a specific gravity of 3.365–3.385, and the composition of a lime-soda epidote or a zoisite, to which latter species it was referred. In this connection he called attention to the observation of Rammelsberg, that zoisite is apparently identical in centesimal composition with meionite, the most basic of the scapolites, which has a hardness of 6.0, a specific gravity of 2.6–2.7, and is readily decomposed by strong acids. It was further noticed that while boiling concentrated sulphuric acid did not attack pulverised saussurite "it was, however, partially decomposed by this acid after having been strongly ignited." Attention was then called to changes produced in the denser silicates by heat, and it was noted that epidote, according to Rammelsberg, has its density reduced from 3.40 to 3.20 by ignition, while saussurite, according to the original observation of Saussure himself, is converted by fusion into a soft glass having a density of 2.8. The specific gravity of garnet was found by Magnus to be reduced one fifth by fusion, and that of idocrase from 3.34 to 2.94.[3] The silicates thus modified by heat are, like meionite and nephelite, decomposable by acids, and all these facts were adduced as evidences that the action of heat is to reduce such complex silicates to simpler and less dense forms.

§ 30. In conclusion it was said that "the two silicates zoisite and meionite offer a remarkable example of that isomerism in mineral species upon whose importance I have

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[1] Ad. Wurtz, Rep. de Chimie, 1860, ii. 464; also Jour. Chem. Soc., of London, 1862, p. 387; and Leçons de Philosophie Chimique, 1864, p. 180. See farther, on polysilicates, Naquet, Principes de Chimie, 1867, i. 175.

[2] Contributions to the History of Euphotide and Saussurite, Amer. Jour. Science, 1859, xxvii. 336-349.

[3] The observations of Greville Williams on beryl show that this mineral, having a density of 2.65–2.69, when fused before the oxyhydrogen blowpipe gives a clear glass, which may be scratched by quartz, and has a density of 2.40–2.42. The fusion of quartz gives in like manner a glass to which a density of 2.22 has been assigned. Williams, in repeating the experiment with rock-crystal of density 2.65, obtained before the oxyhydrogen blowpipe fused globules which in five experiments gave a specific gravity of 2.17–2.21. He noted moreover that alumina thus fused, as in the experiments of Gaudin, becomes crystalline on cooling, and has a density of only 3.45; that of corundum being about 4.00. The crystals of alumina got by the mothod of Frémy and Feil, which consists in decomposing an aluminate of lead by fusion in contact with silica, have however all the characteristics of corundum, and a density of 3.9–4.1, (Greville Williams, Proc. Roy. Soc. London, 1873, p. 409, and also Fouqué and Michel Lévy, Synthèse des Mineraux, etc., p. 222.)

long insisted. The relation of the specific gravity to the empirical equivalent weights of minerals, must enter as an essential element into a classification which shall unite the chemical and natural-historical systems. Similar isomeric relations exist between cyanite and sillimanite (fibrolite), rutile and anatase, and, as I have elsewhere endeavoured to show, among the carbon-spars. It becomes necessary in the study of mineral species to determine their relative equivalent weights, to which specific gravity must be the chief guide."

§ 31. The relations of the members of the scapolite group[1] as a series parallel to the feldspars, already pointed out by the author in 1855, were not lost sight of, nor their connection with saussurite, but were the subject of a communication to the French Academy of Sciences in 1863, which was translated by the author and published at the time in the *American Journal of Science*[2] as already noticed in § 10. In this paper, after recalling the general argument so often set forth as to the principles of a new system of mineralogical classification, it was said "Meionite, with the oxygen ratios 3 : 2 : 1, is the most basic term known of the series of the wernerites (scapolites). The proportion of silica in these minerals augments until we reach in dipyre the ratios 6 : 2 : 1, with a density which does not exceed 2.66. We might then expect to find a silicate which should be to dipyre what zoisite or saussurite is to meionite, and Mr. Damour has recently had the good fortune to meet with such a mineral in a specimen of jade from China, of which he has given us the description and the analysis. (*Comptes Rendus*, May 4th, 1863.) This substance closely resembles in its physical and chemical characters the saussurite or jade from Monte Rosa, of which it has the density, 3.34. It is a silicate of alumina, lime, and soda, and gives the same empirical formula as dipyre. We may expect to find between saussurite and this new species, to which Damour gives the name of jadeite, other jades having formulas which will correspond with the wernerites intermediate between meionite and dipyre. . . . By its hardness, its specific gravity, and its indifference to acids, jadeite is completely separated from the wernerite group, and takes its place alongside of zoisite or saussurite, with the garnets, idocrase, and epidotes."

§ 32. To this last succeeded the paper of 1867, on "The Objects and Methods of Mineralogy," already noticed (§§12–14), in which was given a review of the subject as discussed by me in various publications from 1853 up to that date. Before proceeding to show the systematic application of the principles already set forth, it is proposed to consider further the question of the relation between the atomic weights and densities, so often insisted upon in the above publications. The study of the so-called equivalent or atomic volumes of solid and liquid species, got by dividing the assumed equivalent weight of these by their specific gravities—water being taken as unity,—has occupied the attention of many chemists since the early investigation of the subject by Le Royer and Dumas. The application of this method to hydrocarbonaceous bodies, or to hydrated or double salts of admitted high equivalent, is comparatively simple, but it becomes more difficult when we have to deal with such compounds as mineral silicates, for which, as in the case of feldspars, micas,

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[1] The scapolites have very lately been taken up and discussed from the author's point of view by Tschermak, Monatshefte der Chemie, December, 1883, as will be noticed further on. The slight change in the empirical formula of meionite suggested by Tschermak does not effect the present argument.

[2] Compte Rendu de l'Acad., June 29, 1863, and Amer. Jour. Science, 1863, xxxvi. 426-428, also the author's Chem. and Geol. Essays, p. 446.

epidotes, and tourmalines, the ingenuity of mineralogical chemists has devised chemical formulas often exceedingly complex and difficultly commensurable. For all such cases I have shown that the atomic formulas already described furnish a simple solution.

§ 33. In the atomic notation adopted by me since 1853, the ordinary chemical symbols of the elements are employed to represent one part by weight of hydrogen, or eight parts by weight of oxygen, and the proportions of other elements which unite with these respectively. In other words the coefficients of the symbols of the elements, in the ordinary notation are multiplied by the atomicities of the respective elements, for the atomic notation. The symbols in the latter are distinguished from those representing equivalents by the use of small letters, and to prevent the confusion which might otherwise arise from the absence of capital letters in the formulas, a coefficient is in all cases employed after the symbol of the element; while in constructing condensed formulas the values of m may be represented by fractions. Thus, the general formula of pyroxene in the ordinary equivalent notation being $n(\mathrm{si_2m_1o_3})$, if the value of n be 30, and $\mathrm{m} = (\mathrm{ca_{\frac{3}{6}}mg_{\frac{2}{6}}fe_{\frac{1}{6}}})$, the atomic formula of pyroxene will be $\mathrm{si_{60}(ca_{15}mg_{10}fe_5)o_{90}}$.

§ 34. But as we have elsewhere shown (§ 21), the variable relations between silica, alumina, and protoxyds, in closely related species; the intervention of boron and titanium on the one hand, and of sulphur, fluorine, and chlorine on the other, permit a further generalization, by which silicates are affiliated to quartz on the one hand, and to corundum and spinels on the other. We thus arrive at a general atomic formula $n(\mathrm{A+E})$ in which A represents an atom of silicon, boron or titanium, or of hydrogen or any metal, and E an atom of oxygen or sulphur, or of fluorine, chlorine or oxysulphion. Dividing now the molecular weight of the compound by n we get the value of A+E, which is the mean weight of the individual or atomic unit of the species, whether this be oxyd, silicate, oxyfluorid, oxychlorid or oxysulphid, and it is this weight, designated as P, which for each such species must be the term of comparison in fixing the atomic condensation of the species. The mean unit-weight thus deduced, divided by the specific gravity of the species, water being unity, gives the volume, V, of the atomic unit. In silicates, the value of P is deduced by dividing that of the empirical atomic formula by the whole number of oxygen atoms, to which, in the case of oxyfluorids, oxychlorids or oxysulphids, the number of atoms of fluorine, chlorine or sulphur, is to be added. In this way only is it possible to obtain direct comparisons of volume between different mineral species, as was indicated in 1852, and will be fully shown in the third part of this paper.[1]

§ 35. The principles hitherto maintained by the author as the basis of a natural system in mineralogy, may be resumed as follows :—

1. The conception of high equivalent or molecular weights like those of the carbon series in so-called organic chemistry, extended to all mineral compounds; as was especially maintained for the carbon-spars, the spinels, and the various natural silicates, and illustrated by the hypothesis of polysilicates and polycarbonates with many atoms of base.

[1] Dana, in his inquiry into the subject of atomic volumes in 1850 (Amer. Jour. Science, ix. 221), proposed to divide the volumes deduced from the empirical chemical formulas by the number of atoms of elements in these formulas. Thus ($\mathrm{O} = 8$), SiO_3, Al_2O_3 and CaO, were, in the notation adopted by him, supposed to contain respectively four, five and two elemental atoms, whereas in atomic notation they evidently correspond to three, three and one oxyd-units. Hence, as I long since showed, the results obtained by such a discussion of atomic volumes were fallacious. (Amer. Jour. Science, 1853, xvi. 214.)

2. The conception that the laws of progressive or homologous series, previously recognized only in hydrocarbonaceous bodies, must be extended to mineral species, and are of universal application.

3. The conception that the variations observed in the chemical composition of such mineral species are due, not only to their highly polybasic character, but also, in certain cases, to indefinite admixtures of homœomorphous species, as previously indicated by Delesse, Scheerer and Von Waltershausen, extended and generalized by myself, and subsequently adopted by Tschermak.

4. The attempt to fix the molecular weights of such compounds as the polysilicates and polycarbonates from their densities as compared with those of species, the minimum molecular weights of which are otherwise determined; and the assumption that for homœomorphous solids, and probably for all, the molecular volumes are identical.

5. The adoption of atomic formulas to represent the composition of mineral species, and the showing that comparisons of the volumes or spatial relations of complex species like the silicates, should be based on the numbers which are deduced from these atomic formulas, and which represent the relative volumes of the unit-weight in the species compared. P being the unit-weight got by dividing the empirical molecular weight by the number of oxyd-atoms in the formula (including any chlorid, fluorid or sulphid atoms which may be present), and D the specific gravity, the volume of the unit, designated as V, is represented by the quotient got by dividing P by D.

6. The showing that, in related and homologous species, the hardness and chemical indifference are inversely as the value of V; or in other words, that they increase with the condensation, the relative amount of which in the species compared is shown by the diminution of V.

III.—A Classification of Silicates.

§ 36. In order to show the application of the principles already set forth in the second part of this paper to the classification of mineral species, I have chosen the Natural Silicates, for the reason that, while they present the most complex and the largest group of native species, their physical and their chemical history alike have been more thoroughly studied than those of any other group. To this it may be added that the writer has, for many years, employed a classification based on these principles for the arrangement of his own private collection of the native silicates. These may be regarded as constituting one great natural order, and, without again adverting to the importance of considering in a natural system alike the chemical and the physical history of species, it may be said that a fundamental distinction in silicates is that presented by their chemical constitution, as including either protoxyd or sesquioxyd bases, or both united; for which reason the order Silicate is divided into three suborders: Protosilicate, Protopersilicate, and Persilicate.

The names of protoxyd and protosalt for ferrous compounds, and of peroxyd and persalt, instead of sesquioxyd and sesquisalt, for ferric compounds, are familiar to chemists; and when, in naming the suborders of silicates it became necessary to select a term to designate alike ferric compounds, aluminic compounds, and those in which ferric and aluminic sesquioxyds partially replace each other, I ventured to substitute for sesquisilicate and protosesquisilicate the shorter and more euphonious names of persilicate and proto-

persilicate. With these sesquioxyd bases, which also include chromic and manganic oxyds, is ranged zirconia, since, notwithstanding the quadrivalence of zirconium, the relations of its oxyd in silicates are such as to place it at the side of alumina. Boric, titanic, niobic and tantalic oxyds, all of which are found in silicates, are ranged, as already stated, with silica, which they are regarded as replacing.

§ 37. Inasmuch as zirconia and chromic and manganic oxyds are but exceptionally present in silicates, and ferric oxyd, though more commonly found than they, is much less frequent therein than the alumina which it sometimes replaces, it may be said that it is essentially the relations of alumina to the protoxyds and to silica which we are now called to consider. Native silicates may be divided into those with and those without alumina, the latter division constituting the first suborder—*Protosilicate.* Again, the aluminiferous silicates either contain combined protoxyds, constituting the second suborder—*Protopersilicate;* or are without protoxyds, making the third suborder—*Persilicate.* The presence or absence of combined water, it being an element widely diffused in nature, is of subordinate importance in the study of the silicates. Upon the general distribution of silica and alumina in the crust of the earth, and the relations of these to each other, to protoxyd bases, and to igneous and aqueous solvents, is based the whole genetic history not only of the three suborders of silicates, but of quartz and the non-silicated oxyds.

The affinities which determine the nearly contemporaneous formation of protosilicates and of protopersilicates are displayed in many different and unlike conditions which merit especial consideration. This distinction is well seen in the basic crystalline rocks, wherein pyroxene and chrysolite, often with magnetite, are found side by side with feldspars. Whether this separation, which may be supposed to have taken place in a plutonic magma, was effected with or without the intervention of water, is immaterial to our present inquiry, since we know that the chemical affinities involved lead to similar results alike in the presence and the absence of water, and through a wide range of temperature. Thus, a slow cooling from igneous fusion, as shown in the experiments of Fouqué and Michel Levy, enables us to separate from the same basic magma successively chrysolite, magnetite, pyroxene and feldspar. That similar affinities come into play in presence of water at elevated temperatures is shown by the minerals in concretionary granitoid veins, where wollastonite, amphibole and pyroxene are found crystallized with feldspars, scapolite, micas, garnet and epidote, often with free quartz on the one hand and with magnetite, spinel and corundum on the other.

§ 38. A similar differentiation of protosilicates and protopersilicates is presented in the secretions from basic rocks. In the veins and geodes found in such rocks are seen, side by side, the protosilicates, pectolite, okenite, datolite and apophyllite, and the protopersilicates represented by prehnite, epidote, and the various zeolites, and more rarely by orthoclase and albite, by garnet and tourmaline,—both quartz and magnetite being also present. The same distinction is observed in the products now forming in the channels of certain thermal springs, where pectolitic and zeolitic silicates are associated. Nor is the differentiation less marked when, as in the experiments of Daubrée, water at a high temperature acts upon glass. A protosilicate allied to okenite is then formed, together with pyroxene and quartz, the alkaliferous solution retaining silica, with a portion of alumina. From similar superheated solutions, holding other proportions of these same elements,

crystals of orthoclase, of albite, of analcite and other zeolites, with quartz and tridymite, have been obtained.

§ 39. To these considerations on the genesis of the two suborders of protosilicates and protopersilicates must be added the history of their decay and transformations. It is known that the subaërial decay of protosilicates through the action of atmospheric waters effects their complete decomposition. The lime and magnesia of amphibole, pyroxene, and chrysolite, are thereby dissolved, together with a large proportion of the silica itself; a part of this, however, according to Ebelmen, remains behind, together with the iron changed from a ferrous condition to that of ferric hydrate. In the subaërial decay of such protopersilicates as the feldspars and closely related species, the protoxyd bases, chiefly alkalies and lime, pass into solution, together with a large part of the silica; and the alumina united with the remainder of the silica, and with a portion of water, remains as an insoluble compound, which in many cases has the composition of kaolin. This decay of the feldspars plays an important part in terrestrial chemistry. The process is slow and gradual, and the feldspar softens and becomes disintegrated before the loss of protoxyds is complete, so that the clays thus formed still retain, in many cases, a portion of alkali which may amount to two or three hundredths. The decomposition of the more basic feldspars and feldspathic minerals will be considered farther on, as also the genesis of various micaceous and colloid or clay-like persilicates.

§ 40. From the subsequent transformation of clays more or less completely deprived of alkalies, are apparently derived, in many cases at least, muscovitic micas and tourmaline, together with the crystalline persilicates, kaolinite, pyrophyllite, andalusite, cyanite, fibrolite and related species. The micas just mentioned are more stable under atmospheric influences than the feldspars, while those which like phlogopite and biotite abound in protoxyds, yield readily to decay. The harder and gem-like protopersilicates resist to a greater extent this process, and the more common species of these—garnet, epidote and tourmaline—are found unchanged in sands with persilicates such as andalusite, topaz and zircon, and with quartz, corundum, spinel and menaccanite.

Thus the natural processes of subaërial decay destroy the protosilicates, and transform the predominant types of protopersilicates, either into more highly aluminous and more stable types of the same suborder, or into persilicates; in all cases with the separation of the elements of protosilicates, that is to say, of silica and protoxyd bases. Of these, while iron is separated in an insoluble ferric state, the alkalies and lime, as well as the magnesia of the protosilicates, pass into the condition of carbonates, the silica being liberated in a soluble form.

§ 41. The minerals of granitoid veins, and those secreted in basic rocks, show that a distinct subterranean process of solution of silicated compounds goes on under conditions as yet imperfectly understood, and probably under the influence of thermal alkaline waters, From the matters thus dissolved come, not only the protopersilicates deposited in the forms of zeolites, and of feldspars, micas, garnets and tourmalines; but also the calcic and alkaline protosilicates which take the forms of pectolite, xonaltite, okenite, apophyllite and wollastonite. Such protosilicate solutions, coming in contact with atmospheric carbonic dioxyd, would be decomposed with separation of carbonates, but with dissolved magnesian salts would yield by double exchange silicates such as sepiolite, talc, serpentine, enstatite, chrysolite and their associated amphiboles and pyroxenes. It will be remembered that

these protosilicates may, like the feldspars, be formed alike by aqueous and by igneous processes, and that a broad distinction as to origin must be drawn between those anhydrous silicates, of both suborders, which are due to aqueous deposition, and are often associated with calcite and with quartz, and the same species which are found in plutonic rocks, and may be the result of crystallization from a cooling igneous mass. Propertosilicate solutions, by like reactions with magnesian salts may, by double exchange, give rise to compounds like iolite, the magnesian micas and the chlorites, while the source of glauconite is probably to be sought in the reaction between dissolved protosilicates and ferrous solutions, followed by a partial peroxydation of the resulting hydrous ferropotassic silicate. Thus, as we have endeavoured to show, while natural processes, both igneous and aqueous, unite in giving origin to the protosilicates and the protopersilicates, it is the transformation of the latter by subaërial aqueous action, which, by removing the protoxyd bases, generates the persilicates.

§ 42. While the distinctions between the suborders which have been deduced from their genetic history are generally well defined, there are, however, two remarkable examples which serve to connect the protosilicates with the protopersilicates. With the typical species of amphibole and pyroxene, which are protosilicates, there have hitherto been included certain compounds which, while apparently identical with these in external characters, contain notable portions of alumina. Taking as a type of the aluminous amphiboles, a lime-magnesia pargasite, we find for the atomic ratio of protoxyds, alumina and silica, 2 : 1 : 3, which requires alumina 15·9, silica 42·2. This, if the alumina replaces atomically, as has been suggested, a portion of the silica, would give the ordinary amphibole ratio of 2 : 4. It is, however, a true protopersilicate, having the same atomic ratios as melilite. The example offered by species like amphibole and pargasite, which, from physical characters alone, would be referred to the same genus, shows in a striking manner the importance of chemical considerations in mineralogy. The most highly aluminous pyroxenes contain only about one half as much alumina as pargasite, and might perhaps be regarded, together with the less aluminous amphiboles, as crystalline admixtures of protopersilicates of the pargasite type with a homœomorphous protosilicate.

A wider view of the problem, however, leads us, while admitting the possible existence of such admixtures, to see that from melilite and pargasite, in which the atomic ratios of protoxyd and alumina are 1·0 : 0·5, we have a series in which the ratio becomes, as in humboldtilite, 1·0 : 0·4, and so on to the less aluminous amphiboles and pyroxenes, in which it becomes 1·0 : 0·1 or even less, establishing a transition through these species to the protosilicates. In like manner, towards the other limit of the protopersilicates, we find this ratio changing from 1·0 : 6·0 to 1·0 : 9·0 and 1·0 : 12·0, in indicolite, rubellite and the muscovitic micas; thus marking the transition to gem-like persilicates like andalusite and topaz, and to persilicate micas like kaolinite and pyrophyllite.

§ 43. We may conceive the relation of the three suborders to each other to be represented by a design of two bands of equal breadth, but of unlike color, and of diminishing intensity of color, protracted in opposite directions along a common course, for a considerable part of which the two bands overlie or rather blend with each other. The unmingled portions of these two color-bands represent the protosilicates and the persilicates. As a result of such an arrangement, the protopersilicates, towards the protosilicate end of the continuous series, include comparatively little alumina, as in melilite, pargasite

and phlogopite, while towards the persilicate end they hold but little protoxyd, as seen in indicolite, rubellite, the muscovites and pinite.

§ 44. It follows from what has been already set forth that the more or less arbitrary ratios generally assigned by chemists to various silicates, and deduced from empirical formulas which in many cases represent but approximately the results of chemical analysis, are not always to be regarded as exact. Thus in examining the various formulas hitherto devised for protosilicates, we find that for the whole succession from chondrodite to apophyllite, the atomic proportions between the bases and the silica may be represented by some twelve simple ratios between 4 : 3 and 1 : 7. It is probable, in view of the complex constitution, involving from twenty to thirty atoms of base, which we have assigned to these polysilicates, that, while some of these ratios are exact, others represent but approximations to the truth. The same remark applies with equal force to the persilicates, where a like number of similar ratios is made to include all of the known species. In the present state of our knowledge of their composition, however, the usually accepted atomic ratios of oxyds and silica are retained for the formulas and the tabular views of protosilicates and persilicates given further on.

§ 45. In the study of both of these suborders we note many mineralogical resemblances between species which differ widely in atomic ratios, and similar resemblances become still more apparent when we examine the larger and more complex group of the protopersilicates. Here, for example, in the families of the zeolites, the feldspars and the scapolites, we find physically similar and homœomorphous species in which, with a constant ratio of protoxyds and alumina, the silica is variable. The same thing may be observed among the micas of this suborder; as when corundophilite is compared with biotite, or margarite with certain muscovites. These latter also present another type of variations in composition, for in different analyses of muscovite, while the ratio of sesquioxyd and silica remains unchanged, that of the protoxyds, represented by alkalies, is variable. Both of these modes appear in the tourmaline group, where species physically similar present at the same time variations in the ratio of protoxyd bases to alumina and in that of alumina to silica. These divergences in chemical composition, without sensible changes in external characters, afford strong arguments in favor of the necessity of the aid of chemistry in a true mineralogical classification.

§ 46. To distinguish in general formulas between protoxyd metals on the one hand, and aluminium and its replacing elements on the other, several devices have been proposed by chemists, of which the most simple is perhaps the employment of Roman and Italic letters respectively. Accordingly, in these pages *m* is used for an atom of aluminium, ferricum, manganicum, chromicum or zirconium, while m represents an atom of any other metal, and (the presence of oxygen being understood) the atomic ratios of the protosilicates are given under the head of m : si, those of the persilicates, *m* : si, and those of the protopersilicates, m : *m* : si.

§ 47. Having shown the wide chemical differences existing between the three great divisions of the order Silicate, we proceed to consider those differences, alike chemical and physical, which are found between species often having identical or similar centesimal composition. Physical characters, irrespective of chemical composition, constitute, in the language of Mohs, the characteristic of mineral species, and served as the basis of his system of classification. We propose to show that, by a re-examination of these characters in the

light of modern chemistry, it is possible to devise a new mineralogical method which shall retain all that was good in the Natural History System, and at the same time bring it in accordance with the facts of chemistry, thus giving a veritable Natural System to Mineralogy.

§ 48. The great divisions marked by external characters were made by Mohs and his school the basis of a system of classification, as is exemplified in his orders of MICA, SPAR, and GEM, already noticed in § 5–6. We have there seen the heterogeneous nature of the order SPAR, wherein—besides the genera, *Schiller-Spar*; *Disthene-Spar*, including cyanite; *Triphane-Spar*, comprising spodumene and prehnite; *Petaline-Spar* for petalite; *Azure-Spar* for lapis-lazuli and lazulite; *Augite-Spar*, including pyroxene, amphibole, wollastonite and epidote; *Feld-Spar*, embracing adularia, albite, anorthite, labradorite and scapolite—there was a genus, *Kouphone-Spar*, in which were grouped not only leucite and sodalite, but the characteristic zeolites, mesotype, laumontite, harmotome, analcite, chabazite, stilbite and heulandite. With these was also placed apophyllite, while datolite was assigned to another genus, *Dystome-Spar*. When, in 1844, Shepard divided the order SPAR by the separation from it of a new order, ZEOLITE, he transferred to this the whole of the species of the latter two genera. The order SPAR of Mohs, and the united orders of SPAR and ZEOLITE of Shepard thus included alike protosilicates, protopersilicates and persilicates of very various degrees of hardness and chemical unlikeness; since not only datolite, apophyllite and pyroxene, but mesolite and stilbite, leucite and albite, spodumene and epidote, and even cyanite found a place therein. A still more heterogeneous assemblage was seen in Dana's order, CHALCINEA, which comprised not only the order SPAR of Mohs, but also the protopersilicate micas of his order MICA.

§ 49. We propose, while keeping in view the great chemical suborders already defined in our system, to group mineral species with more regard to these external characters than has hitherto been done. The obvious distinctions of structure, hardness and density, which separate protopersilicates like garnet, staurolite, and tourmaline, from the micas on the one hand, and from the feldspars, scapolite and zeolites on the other, though but imperfectly appreciated, underlaid the division by Mohs into Gem, Mica and Spar, and the necessity of a subdivision of the sparry or spathoid type was soon felt by Shepard. The need of this is most apparent in the great suborder of the protopersilicates, where it will be seen that, alike on chemical and physical grounds, the natural line of division coincides with that between hydrous and anhydrous species,—the latter including the feldspars, leucite, sodalite and scapolites, and the former or hydrospathoid, the zeolites. A similar distinction of hydrous and anhydrous spathoids is equally marked in the protosilicates. Upon the foregoing distinctions, and upon the still farther one, which in each suborder separates all these crystalline species from amorphous colloid compounds, we may proceed to divide the various suborders into Tribes.

§ 50. Beginning with the PROTOSILICATES, we recognize first among them a type of crystalline hydrous species of inferior hardness and comparatively low density, which are decomposed by strong acids with the formation of a jelly, or to use Graham's phrase, pectise with acids. These hydrospathoids, which are represented by pectolite, apophyllite, datolite, calamine, etc., may be conveniently designated as the tribe of the *Pectolitoids*. A second type, not very dissimilar to the first, but somewhat harder, and anhydrous, though still pectising with acids, is represented by willemite, tephroite, helvite, wollastonite,

etc. These anhydrous spar-like species we designate as the tribe of the *Protospathoids*. In the third place we note a group of species not unlike the second in general aspect and, like them, generally anhydrous; which are, however, harder and considerably denser, as appears from the reduced value of V. This group is represented by chondrodite, chrysolite, phenacite, amphibole, pyroxene, danburite, titanite, etc. Many of these species present a hardness and transparency which caused them to be included by Mohs and his school in the order GEM, and this gem-like or adamantoid character suggests for them the tribal name of *Protadamantoids*. As regards their relation to acids, it may be noted that while the spathoid wollastonite is readily decomposed thereby, the corresponding adamantoid bisilicates, amphibole and pyroxene are unattacked. The highly basic chrysolite pectises with acids, but the more condensed phenacite and bertrandite, with the same atomic formula, resist their action. The case of titanite, a titanosilicate, is peculiar, for the reason that the titanic oxyd, of which it contains so large a proportion, is soluble in hydrochloric acid. This decomposition of titanite was long since studied by the writer, who showed that the titanic oxyd thus dissolved presents chemical reactions very different from that got from menaccanite by the same solvent, or from titanite itself by the action of hot sulphuric acid, and then described it as a peculiar modification of titanic acid.[1]

§ 51. We recognize in the fourth place among the protosilicates a group characterized by a hardness less than that of the three preceding tribes, and by a very marked basal cleavage, yielding more or less flexible laminæ, as is well seen in talc and in the foliated serpentines. This type, but sparingly shown in the first suborder, is largely developed in the micas and the chlorites of the second, and from its foliated structure is naturally designated as phylloid, for which reason the fourth tribe of the protosilicates may be called *Protophylloids*. There still remains in this order a considerable group of soft hydrous silicates, chiefly magnesian, represented by much that is called serpentine, by deweylite, cerolite, chrysocolla, etc. To these the tribal designation of *Ophitoids*, suggested by the Greek name for serpentine, is given. They are, for the most part, readily decomposed by acids without pectisation, and are amorphous colloid substances. The crystalline silicates which approach these protocolloids in physical and chemical characters—in part phylloids, and in part perhaps spathoids,—will be considered in the further discussion of the ophitoids.

§ 52. Passing now to the second suborder, that of the PROTOPERSILICATES, we recognize, as in the protosilicates, five tribes, which repeat the general characters of those just noticed. The first is that of the great family of the zeolites, with prehnite and some related species, which together constitute a hydrospathoid tribe conveniently designated as *Zeolitoids*. The resemblances, as regards hardness, density, aspect and mode of occurrence, between this tribe of hydrous silicates and the pectolitoids, are such that, notwithstanding their wide difference in chemical composition, the calcareous pectolitoids have generally been confounded with the zeolites.

The spathoids of the second suborder, constituting the tribe of the *Protoperspathoids*, include a large number of species represented by melilite, gehlenite, ilvaite, the whole family of the feldspars, sodalite, nephelite, leucite, iolite and petalite, of which the more basic species are, like the protospathoids, decomposed by acids. The *Protoperadamantoids* form a large and important tribe of hard and gem-like species, including pargasite, ido-

[1] Amer. Jour. Science, 1852, xiv. 346.

crase, garnet, beryl, euclase, ardennite, axinite, epidote, spodumene, sapphirine, staurolite, and the tourmalines; besides allanite, the titanic species, keilhauite and schorlomite, and the remarkable ferric species, ægirite, acmite and arfvedsonite. These, though differing in this regard among themselves, have all of them a more condensed molecule than the densest of the spathoids, and it is to be noted that their resistance to acids is correspondingly greater. The highly basic adamantoids of this suborder, such as garnet, epidote and zoisite are not attacked, while the basic spathoids (as scapolites and feldspars) are readily decomposed, by acids. The phylloid type in this suborder is represented by the great group of the micas and chlorites, constituting the tribe of *Protoperphylloids* and including a large number of species, both hydrous and anhydrous, which are more condensed than the spathoids, though less so than the adamantoids.

In the fifth place we find the uncrystalline colloidal species of this suborder represented by the tribe of the *Pinitoids*, named for the typical species, pinite, and corresponding to the ophitoids, with which they have many analogies. This tribe includes several species which are essentially hydrous silicates of alumina, with more or less alkali. With the true pinitoids are probably confounded other substances which are compact forms of the corresponding phylloids. The hydrous silicates palagonite and pitchstone, and the anhydrous tachylite and obsidian, though not definite mineral species, are placed in this tribe, as being colloidal protopersilicates.

§ 53. The hydrospathoid and spathoid tribes are scarcely represented among the less protobasic silicates of the second suborder, and with the exception of westanite, which seems to be a hydrospathoid, are as yet unrecognized in the suborder of the PERSILICATES. The *Peradamantoids*, however, constitute an important tribe, including andalusite, topaz, dumortierite, fibrolite, xenolite, cyanite and the zircons. The *Perphylloid* tribe is represented by a few micaceous species, such as pholerite, talcosite, kaolinite and pyrophyllite; while the uncrystalline or colloid type in this suborder, which we have designated the *Argilloid* tribe, includes the various clays or amorphous hydrous silicates of alumina, from schrötterite through allophane and halloysite to cimolite and smectite, together with wolchonskoite and chloropal.

§ 54. In the preceding scheme it will be seen that the first place has been given to the great chemical distinctions which are embodied in the three suborders of silicates. It might be thought that the well-marked physical types which we have seen recurring in the different suborders should be made the ground of a first subdivision of the order Silicate, rather than the chemical distinctions here adopted. These resemblances, dependant upon similar molecular aggregations and upon physical structure are, however, less fundamental than those based upon elemental constitution, which, as we endeavored to show, are genetic, and should, therefore, have assigned to them a greater significance than those analogies based on similarity of aggregation and structure, which although of much importance in classification, are essentially mimetic. The foundations alike of the order and the suborders are wholly chemical, and the division of each of the suborders into tribes is primarily and essentially chemical and genetic. On the other hand, the remarkable resemblances between the corresponding tribes in the different suborders, which are chemically distinct, is imitative or mimetic, and should, therefore, be assigned a subordinate rank in classification.

§ 55. In arranging still further the different families, genera, and species, in each tribe,

the question arises what kind of chemical variation should take precedence. Considering the general persistence of type in series of protopersilicates like those of the zeolites and the feldspars, in each of which the ratio of protoxyds to alumina is constant, that of the silica being variable, I have, in a tabular view of the suborder, arranged species so related on the same horizontal lines; while species belonging to the same tribe, but having different relations between the protoxyds and the alumina, are arranged in successive horizontal lines, those with the larger proportion of protoxyds being above, and those with the smaller proportion below; so as to represent the passage towards protosilicates in the one direction, and to persilicates on the other. It should here be remarked that in many cases, as in tourmalines and in micas, the species thus vertically arranged present physical resemblances not less close than those between species on the same horizontal line, as may be seen in the synoptical table of the protopersilicates mentioned below. As regards the relative condensation, the successive species or genera of a tribe on a given line may be placed with regard to the value of V; the denser, or those with the lesser atomic volume, following those which are less dense.

§ 56. The suborders and tribes of the order Silicate, as already set forth, including the possible *Hydroperspathoids* and *Perspathoids*, are presented in the following table, which is succeeded by a list of the principal species in each tribe. The several minerals of the various tribes in their sequence will then be briefly noticed, and tables of them will be given, showing the atomic formulas of the species, and the values of P and V as calculated therefrom. Finally, the minerals of each suborder, arranged under their respective tribes in the sequence already explained, will be presented in synoptical tables, giving at a single view the new classification of the silicates.[1]

I. ORDER SILICATE.

SUBORDER.	I. PROTOSILICATE.	II. PROTOPERSILICATE.	III. PERSILICATE.
Tribe.	1. Hydroprotospathoid (Pectolitoid).	6. Hydroprotoperspathoid (Zeolitoid).	11. Hydroperspathoid.
Tribe.	2. Protospathoid. - - - - -	7. Protoperspathoid. - - - - -	12. Perspathoid.
Tribe.	3. Protadamantoid. - - - - - -	8. Protoperadamantoid. - - - -	13. Peradamantoid.
Tribe.	4. Protophylloid. - - - - - -	9. Protoperphylloid. - - - - - -	14. Perphylloid.
Tribe.	5. Protocolloid (Ophitoid). - - -	10. Protopercolloid (Pinitoid). - -	15. Percolloid (Argilloid).

TRIBE 1. PECTOLITOID. Calamine, Thorite, Cerite, Gyrolite, Friedelite, Pyrosmalite, Xonaltite, Plombierite, Hydrorhodonite, Dioptase, Pectolite, Datolite, Apophyllite, Okenite; together with Villarsite, Matricite, Picrosmine, Picrolite and Chrysotile. (Table II.)

TRIBE 2. PROTOSPATHOID. Danalite, Willemite, Batrachite, Tephroite, Knebelite, Gadolinite, Helvite, Leucophanite, Wollastonite, Tscheffkinite. (Table III.)

TRIBE 3. PROTADAMANTOID. Chondrodite, Monticellite, Chrysolite, Phenacite, Bertrandite, Amphibole, Rhodonite, Pyroxene, Enstatite, Guarinite, Titanite, Danburite. (Table IV.)

[1] As regards the designation of the tribes, the use of a term which ends in a syllable expressing likeness to include not only bodies resembling a given type, but the type itself, is justified by the meaning given to such words as haloid, albuminoid and colloid, and also by the use in botany of the name of *Aroideæ* for an order which comprises not only *Araceæ*, but the typical genus *Arum*.

TRIBE 4. PROTOPHYLLOID. Thermophyllite, Marmolite, Talc. (Table V.)

TRIBE 5. OPHITOID. Serpentine, Retinalite, Deweylite, Genthite, Aphrodite, Cerolite, Chrysocolla, Spadaite, Rensselaerite, Sepiolite, Glauconite. (Table VI.)

TRIBE 6. ZEOLITOID. Xanthorthite, Prehnite, Hamelite, Catapleiite, the various Zeolites; with Cancrinite and Ittnerite, Edingtonite, Sloanite, Forestite. (Table VII.)

TRIBE 7. PROTOPERSPATHOID. Melilite, Eudialyte, Wöhlerite, Humboldtilite, Ilvaite, Gehlenite, Sarcolite, Milarite, Barylite, Meionite with Marialite and intermediate Scapolites, Sodalite, Nosite, Hauÿne, Lapis-lazuli, Leucite, Hyalophane, Orthoclase, Microcline, Nephelite, Paranthite, Eucryptite, Anorthite, Albite and intermediate Feldspars, Iolite, Petalite. (Table VIII.)

TRIBE 8. PROTOPERADAMANTOID. Pargasite, Keilhauite, Idocrase, Schorlomite, Garnet, Ægirite, Allanite, Beryl, Euclase, Arfvedsonite, Ardennite, Axinite, Epidote, Zoisite, Jadeite, Acmite, Spodumene, Sapphirine, Staurolite; and the Tourmalines, including Coronite, Schorlite, Aphrizite, Indicolite, Rubellite, (Table IX.)

TRIBE 9. PROTOPERPHYLLOID. Astrophyllite, Phlogopite, Pyrosclerite, Penninite, Ripidolite, Prochlorite, Leuchtenbergite, Venerite, Corundophilite, Biotite, Voigtite, Cryophyllite, Seybertite, Thuringite, Jefferisite, Annite, Willcoxite, Chloritoid, Lepidomelane, Zinnwaldite, Oellacherite, Lepidolite, Margarite, Euphyllite, Cookeite, Damourite, Paragonite, Muscovite. (Table X.)

TRIBE 10. PINITOID. Jollyte, Fahlunite, Esmarkite, Bravaisite, Hygrophilite, Pinite, Cossaite; with Palagonite, Tachylite, Pitchstone and Obsidian. (Table XI.)

TRIBE 11. HYDROPERSPATHOID. No species known except perhaps Westanite.

TRIBE 12. PERSPATHOID. No species known to represent this tribe.

TRIBE 13. PERADAMANTOID. Dumortierite, Topaz, Andalusite, Fibrolite, Cyanite, Bucholzite, Xenolite, Wörthite, Lyncurite, Malacone, Zircon, Auerbachite, Anthosiderite. (Table XII.)

TRIBE 14. PERPHYLLOID. Pholerite, Talcosite, Kaolinite, Pyrophyllite. (Table XIII.)

TRIBE 15. ARGILLOID. Schrötterite, Collyrite, Allophane, Samoite, Halloysite, Kaolin, Keramite, Wolchonskoite, Montmorillonite, Chloropal, Cimolite, Smectite. (Table XIV.)

Tribe 1.—PECTOLITOID.

§ 57. We notice first in this tribe those hydrated silicates of lime, often with alkalies, some of which are frequently found among the secretions of basic rocks, and which include pectolite, xonaltite, gyrolite, plombierite, datolite, okenite and apophyllite. The name selected for the tribe recalls at the same time the most common of these species, and also the property which belongs to most of them of pectising or being decomposed by strong acids, such as chlorhydric, with the separation of gelatinous silica. It has also the advantage of distinguishing them from the zeolitoids, the corresponding type in the next suborder, with which they are generally associated and sometimes confounded. Differing considerably in the proportion of combined water, the pectolitoids have a hardness below that of quartz and, with but few exceptions, a comparatively large atomic volume. In the case of apophyllite a little fluorine is present, and in datolite a large amount of boric oxyd, which in our atomic formula is represented as replacing a portion of silica. They are all native species, some of which have been artificially formed, and at least one of them, apophyllite, is found of recent origin in the channels of the thermal waters of Plombières, in France, where another species, plombierite, has alone been met with. An unnamed pectolitoid was got by Daubrée as a product of the action of superheated water on glass. Belonging to this same tribe are: the zinc-silicate, calamine; the rare species, thorite and cerite; the two manganesian silicates, friedelite and hydrorhodonite, with pyrosmalite, a ferro-manganesian species containing chlorine; and the copper-silicate, dioptase. The composition of tritomite is not certain, but approaches that of cerite. Here, also, mosandrite probably belongs.

§ 58. We place here also chrysotile, which constitutes the common amianthus, and has hitherto been regarded as a variety of serpentine, with which it agrees in centesimal composition. It is, however, distinguished therefrom by much lower specific gravity, and its fibrous character which, like that of amianthoid amphibole, indicates a prismatic crystallization. As will be shown farther on, at least two other species, one phylloid and another ophitoid, have been confounded under the name of serpentine. While the density of these last is 2·60 or higher, that of chrysotile, according to three determinations, is

II. *Tribe* 1. PECTOLITOID.

SPECIES.	FORMULA.	P	D	V	CRYS.	REMARKS.
Calamine. - - -	$(zn_1si_1)o_2 + 2aq$ - - - - -	24·00	2·40	6·87	Orthorh.	
Thorite. - - -	$(th_1si_1)o_2 + 1\frac{1}{3}aq$ - - - - -	34·50	5·40	6·38	Isomet.	
Cerite. - - - -	$(ce_1si_1)o_2 + 1aq$ - - - - - -	29·00	4·90	6·00	—— ?	ce, la, di.
Gyrolite. - - -	$(ca_2si_3)o_5 + 1aq$ - - - - -	....	....	....	....	
Friedelite. - - -	$(mn_2si_3)o_5 + 2aq$ - - - - -	19·19	3·07	6·23	Rhombo.	
Pyrosmalite. - -	$(fe_2si_3)o_5 + 1aq$ - - - - -	21·00	3·17	6·62	Hexagon.	Oxychlorid.
Chrysotile. - -	$(mg_3si_4)o_7 + 2aq$ - - - - -	15·33	2·22	6·98	—— ?	
Xonaltite. - - -	$(ca_1si_2)o_3 + \frac{1}{4}aq$ - - - - -	18·53	2·71	6·33	—— ?	
Plombierite. - -	$(ca_1si_2)o_3 + 2aq$ - - - - -	....	....	....	....	
Hydrorhodonite.	$(m_1si_2)o_3 + 1aq$ - - - - -	17·65	2·70	6·53	—— ?	mn : mg :: 3 : 1
Dioptase. - - -	$(cu_1si_2)o_3 + 1aq$ - - - - -	19·67	3·34	5·88	Rhombo.	
Pectolite. - - -	$(ca_5si_{12})o_{17} + 1aq$ - - - - -	18·44	2·78	6·63	Clinorh.	
Datolite. - - -	$(ca_2si_4b_3)o_9 + 1aq$ - - - - -	16·00	2·99	5·35	Clinorh.	Borosilicate.
Apophyllite. - -	$(ca_1si_4)o_5 + 2aq$ - - - - -	15·14	2·35	6·44	Tetrag.	Oxyfluorid.
Okenite. - - -	$(ca_1si_4)o_5 + 2aq$ - - - - -	15·14	2·35	6·44	Orthorh.	

2·142, 2·220 and 2·238, the first and the last being by E. S. Smith, and according to his analyses corresponding to specimens containing respectively 2·23 and 3·36 of ferrous oxyd.[1] If this oxyd be to the magnesia as 1 : 30, it would give for P a value of 15·51, which, with a density of 2·22, would make $V = 6·98$.

Fibrous silicates having the same centesimal composition as the last are, however, met with, having a much higher specific gravity. A well defined mineral, described many years since by the writer from Bolton (Quebec) under the name of picrolite, is separable into long rigid elastic fibres, and has, with a specific gravity of 2·607, the composition, silica 43·70, magnesia 40·68, ferrous oxyd 3·51, with traces of nickel and chromium, and 12·45 of water, = 100·34.[2]

§ 59. While the above species of unlike density agree in having the serpentine ratio, 3 : 4 : 2, there are several other hydrous silicates of magnesia which present other ratios, and should like these be included among hydrospathoids. Such are the orthorhombic sparry villarsite, with $D = 2·98$, which has been described as a hydrous chrysolite, and is represented by the atomic formula $(mg_1si_1)o_2 + \frac{1}{4}aq$, and the fibrous crystalline matricite with $D = 2·53$, more hydrous in composition, with the formula $(mg_1si_1)o_2 + 1aq$, nearly.

[1] Amer. Jour. Science, 1885, xxix. 32. [2] Geology of Canada, 1863, p. 472.

The sparry orthorhombic picrosmine, with D = 2·66, which is sometimes fibrous and asbestiform, is a hydrous bisilicate represented by $(mg_1si_2)o_3 + \frac{1}{2}aq$, and Terreil has very recently described as chrysotile from Canada, with D = 2·56, an asbestiform silicate which is at once more basic, more hydrous and denser than ordinary chrysotile, and approaches matricite in composition. His analysis gives silica 37·10, magnesia 39·94, ferrous oxyd, 5·73, alumina traces, water 16·85 = 99·62. This corresponds very closely to $(mg_{6 \cdot 5}fe_{0 \cdot 5}si_8)o_{15} + 6aq$.[1] These various prismatic hydrous silicates of magnesia, including chrysotile and picrolite, constitute an important group of what may be designated as magnesian pectolitoids, which have for the most part an atomic volume approaching to dioptase and to datolite, and demand further study, but with the exception of chrysotile have not been placed in our table.

§ 60. In the accompanying table (No. II) of the principal Pectolitoids are given their atomic formulas as deduced from chemical analysis, the unit-weight, P, calculated from these, the density, D, (water = 1.00) and the atomic volume, V, = P ÷ D. In calculating the value of P for these silicates, we have to consider that two or more protoxyd bases are often present, and that the proportions of these must be estimated as nearly as possible. As the specific gravity of species is in many cases inexactly determined, we have, where more than one value of D is given by mineralogists, selected that which seemed most probably correct, and, where determinations of density are wanting, have left a blank in the table. In a case like friedelite, a manganesian silicate including some magnesia, which has been considered in calculating the value of P, we have indicated in the right-hand column of the table the relative proportions of the two bases. Where the species includes several bases, these are represented in the atomic formula by the general symbol m, and the specification of their nature and their proportions follows in parenthesis.

§ 61. It has been thought well, for reasons which will be apparent when we compare the pectolitoids with other tribes, to represent their contained water by the symbol aq, preceded by the sign +. It will be noted that in the atomic formulas here employed, the symbols of the metals, with those of silicon, boron and titanium, are placed within parentheses, and those of oxygen, sulphur, fluorine and chlorine, together with water, without. From this it will be clear that the atomic weight deduced from these formulas must, in order to arrive at P (the weight of the atomic unit), be divided by the number of these units; that is to say, by the sum of the coefficients of the elements outside of the parenthesis. The present table is far from complete; the determinations of density are in many cases uncertain, those assigned to the same species by different observers often presenting wide variations. Again, the value of P in cerite is calculated as if it were simply a silicate of cerium, while it contains unknown proportions of lanthanum, didymium and samarium. The general agreement in the value of V is noticeable, save in two cases,—that of dioptase, for which another recorded determination of D = 3.28 gives V = 6.00, and that of datolite, whose volume shows a condensation approaching to that of the adamantoid protosilicates.

§ 62. For the better understanding of the formulas given in the accompanying tables of the various tribes of silicates, it may be well to recall the values of the chemical symbols here employed, which are atomic,—the small letters representing atoms of the elements.

[1] Compte Rendu de l'Acad. des Sciences, Jan. 26, 1885.

Hence, while for univalent elements or monads like sodium, chlorine and fluorine, the symbols represent the received equivalent weights, these weights for dyads like glucinum, calcium, ferrosum, oxygen and sulphur, are divided by two; for triads like boron,

ATOMIC SYMBOLS AND WEIGHTS.

o	8·00	k	39·00	mn	27·50	fi	18·66
s	16·00	cs	133·00	cu	31·65	mni	18·50
fl	19·00	gl	4·50	ni	29·00	si	7·00
cl	35·50	mg	12·00	zn	32·50	ti	12·50
h	1·00	ca	20·00	ce	47·00	zr	22·50
aq	9·00	sr	43·75	yt	44·50	sn	29·50
li	7·00	ba	68·50	b	3·66	nb	18·80
na	23·00	fe	28.00	al	9·00	th	58·00

aluminium and ferricum by three, for the tetrads silicon, titanium, tin, zirconium and thorium by four, and for a pentad like niobium by five.[1] Thus the numerical values of the symbols here used are as given above.

III. *Tribe* 2. PROTOSPATHOID.

SPECIES.	FORMULA.	P	D	V	CRYS.	REMARKS.
Danalite.	$(m_7si_6)o_{13}$ - (m = gl, fe, zn) - *a*	22·00	3·43	6·42	Isomet.	Oxysulphid.
Willemite.	$(zn_1si_1)o_2$	27·75	4·18	6·63	Hexag.	
Batrachite.	$(m_1si_1)o_2$ - $(m = ca_{0·5}mg_{0·5})$	19·50	3·03	6·43	Orthorh.	
Tephroite.	$(mn_1si_1)o_2$	25·50	4·12	6·13	Orthorh.	
Knebelite.	$(m_1si_1)o_2$ - $(m = fe_{0·5}mn_{0·5})$	25·37	4·12	6·15	—— ?	
Gadolinite.	$(m_1si_1)o_2$ - (m = ca, fe, yt) - *b*	27·62	4·20	6·57	Orthorh.	
Helvite.	$(m_1si_1)o_2$ - (m = gl, mn)	19·95	3·30	6·03	Isomet.	Oxysulphid.
Leucophanite.	$(m_3si_4)o_7$ - (m = gl, ca, na) - *c*	18·05	2·97	6·04	Orthorh.	
Wollastonite.	$(ca_1si_2)o_3$	19·33	2·92	6·62	Clinorh.	
Tscheffkinite.	$(m_1si_2)o_4$ - (m = ce, ca, fe) - *d*	27·07	4·26	6·36	—— ?	Titanosilicate.

§ 63. In the second tribe, which we have called Protospathoids, shown in table No. III, are the sparry silicates of zinc and manganese, willemite and tephroite, and the ferromanganesian species, knebelite,—all having the ratio of unisilicates. To these are joined the double silicate of lime and magnesia, batrachite, with gadolinite, a silicate chiefly of yttria, giving apparently the same atomic ratios, and helvite, a silicate of glucina and manganese, remarkable for containing a large amount of sulphur; in which respect it

[1] The formulas employed in calculating the values of P and V for the following species are as follows:—

a. Danalite—$(gl_{3·0}fe_{2·0}mn_{0·5}zn_{1·5}si_{6·0})o_{12·0}s_{1·0}$

b. Gadolinite—$(ca_{0·5}fe_{1·5}yt_{6·0}si_{8·0})o_{16·0}$

c. Leucophanite—$(ca_{5·0}gl_{5·0}na_{2·0}si_{16·0})o_{28·0}$

d. Tscheffkinite—[Damour] $(ce_{0·65}fe_{0·20}ca_{0·15}si_{1·30}ti_{0·70})o_{3·00}$

resembles the more basic silicate of glucina, iron and zinc, danalite, belonging to the same tribe. With these are also placed leucophanite, which is interesting as being a fluoriferous silicate of glucina, lime and soda, having the same atomic ratio for its bases as serpentine and chrysotile. Among bisilicates we find, in this tribe, wollastonite, a simple lime-silicate, and tscheffkinite, a titanosilicate of lime with cerous and ferrous oxyds. All of the silicates of this tribe are decomposed by acids with pectisation.

Tribe 3.—Protadamantoids.

§ 64. We next proceed to note the adamantoid protosilicates or Protadamantoids, closely connected with the Protospathoids, but distinguished from them by a more condensed molecule and a greater resistance to acids. First in order comes the fluoriferous magnesian silicate, chondrodite, then the double silicate of lime and magnesia, monticellite, (which, from its recorded specific gravity, would seem to be a denser silicate,

IV. *Tribe* 3. Protadamantoid.

Species.	Formula.	P	D	V	Crys.	Remarks.
Chondrodite.	$(mg_4si_3)o_7$	18·77	3·20	5·86	Orthorh.	Oxyfluorid.
Monticellite.	$(m_1si_1)o_2$ - $(m = mg_{0·5}ca_{0·5})$	19·50	3·25	6·00	Orthorh.	
Forsterite.	$(mg_1si_1)o_2$	17·50	3·30	5.30	Orthorh.	
Chrysolite (1).	$(m_1si_1)o_2$ - $(m = mg_{0·9}fe_{0·1}$	18·30	3·40	5·38	Orthorh.	
Chrysolite (2).	$(m_1si_1)o_2$ - $(m = mg_{0·8}fe_{0·2}$	19·10	3·50	5·45	Orthorh.	
Bertrandite.	$(gl_1si_1)o_2 + \frac{1}{4}aq$	13·31	2·59	5·13	Orthorh.	
Phenacite.	$(gl_1si_1)o_2$	13·85	3·00	4·61	Orthorh.	
Amphibole (1).	$(m_1si_2)o_3$ - $(m = mg_{0·75}, ca_{0·25})$	17·33	2.97	5·88	Clinorh.	
Amphibole (2).	$(m_1si_2)o_3$ - $(m = mg_{0·6}ca_{0·3}fe_{0·1})$	18·00	3·06	5·88	Clinorh.	
Rhodonite.	$(mn_1si_2)o_3$	21·50	3·60	5·97	Clinorh.	
Pyroxene (1).	$(m_1si_2)o_3$ - $(m = ca_{0·5}mg_{0·5})$	18·00	3·27	5·50	Clinorh.	
Pyroxene (2).	$(m_1si_2)o_3$ - $(m = ca_{0·5}mg_{0·5})$	18·00	3·28	5·48	Clinorh.	
Pyroxene (3).	$(m_1si_2)o_3$ - $(m = ca\frac{1}{3}mg\frac{2}{3})$	17·55	3·22	5·45	Clinorh.	
Pyroxene (4).	$(m_1si_2)o_3$ - $(m = ca\frac{4}{8}mg\frac{3}{8}fe\frac{1}{8})$	18·66	3·41	5·47	Clinorh.	
Enstatite (1).	$(m_1si_2)o_3$ - $(m = mg_{0·9}fe_{0·1})$	17·20	3·10	5.42	Orthorh.	
Enstatite (2).	$(m_1si_2)o_3$ - $(m = mg_{0·8}fe_{0·2})$	17·73	3·25	5·42	Orthorh.	
Titanite.	$(ca_1si_2ti_2)o_5$	19·80	3·50	5·65	Clinorh.	Titanosilicate.
Guarinite.	$(ca_1si_2ti_2)o_5$	19·80	3·48	5·65	Tetrag.	Titanosilicate.
Danburite.	$(ca_1si_4b_3)o_8$	16·92	2·95	5·73	Orthorh.	Borosilicate.

isomeric with the spathoid batrachite,) and the chrysolites, belonging to a more condensed type than either. The genus, chrysolite, includes not only the ordinary more or less ferrous species, but forsterite on the one hand, and hortonolite and fayalite on the other. To this succeed the two glucinic species, phenacite and bertrandite, the former of which is the most highly condensed protadamantoid known, while the latter is remarkable for containing a portion of water. Next in order comes the manganesian species, rhodonite, together with the amphiboles and pyroxenes, two important genera, or rather families, which (with the apparent exception of certain amphiboles having the atomic ratio of bases to silica of

4 : 9) are bisilicates. While rhodonite and pyroxene are clinorhombic in crystallization, the magnesian species, enstatite, with hypersthene and diaclasite, is orthorhombic. Anthophyllite appears to be an orthorhombic species having the composition of amphibole, and kupfferite, a magnesian amphibole. Their very varied composition, and the great number of bases which enter into the composition of some of the amphiboles and the pyroxenes, are illustrations of the polybasic character of the silicates.

With the pyroxenes some mineralogists have grouped spodumene, ægirite, arfvedsonite and acmite, the association being based on similarity of crystalline form, and supported by a misconception of their chemical relations. All of these species find their position in the next suborder, and the place of the last three is near to garnet and to epidote. We have already noticed (§ 49) the presence of alumina in certain pyroxenes and certain amphiboles, of which latter pargasite is the type, serving to connect the protosilicates with the succeeding suborder of protopersilicates.

§ 65. The relations of amphibole and pyroxene to each other and to wollastonite, as shown in the unlike degrees of condensation made evident by the different values of V, were pointed out by the present writer in 1853, as examples of isomerism in polysilicates, when the three were represented as belonging to as many homologous types (§ 18.) These relations, so far as amphibole and pyroxene are concerned, were mentioned some years later by Dana, in 1868, when he noticed that the pyroxenes have a specific gravity about one-tenth greater than that of the corresponding amphiboles.[1] The chemical difference between these species and the corresponding spathoids is seen in the resistance of both amphibole and pyroxene to acids, which decompose wollastonite. Rhodonite, a manganesian species with the crystalline form of pyroxene, appears, from its volume, to be more closely related to amphibole, and is partly decomposed by acids. Different and unlike varieties of pyroxene agree closely with each other, with enstatite, and with chrysolite, in the value of V, as will be made evident by the accompanying table, No. IV. In this the four pyroxenes compared were examined and analyzed by the writer.

To this tribe of Protadamantoids we add titanite and guarinite, two titanosilicates of unlike crystalline form, but of identical composition and specific gravity. The solubility of titanite in acids has already been noticed in § 57. Here also is the place of danburite, a borosilicate remarkable for having a value of V, near to that of the pectolitoid borosilicate, datolite. The amphiboles, rhodonite, chondrodite and monticellite, are the adamantoids which approach nearest to the spathoids, from the denser species of which, tephroite, helvite and leucophanite, they are not far removed in volume.

Tribe 4.—PROTOPHYLLOIDS.

§ 66. The phylloid type in the protosilicates is represented by a small number of magnesian minerals, of which the best known is talc, apparently including two species with different atomic formulas, but indistinguishable save by chemical analysis. To these must be added one or more of the species generally classed under the head of serpentine. Among them is thermophyllite, having a recorded density of 2.56-261, while marmolite, with a similar composition, should, if its density be really 2·41, constitute another Protophyl-

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[1] System of Mineralogy, 5th Ed., p. 240.

loid species, as indicated in Table V. From the structure of these minerals, Dana has suggested that serpentine may be micaceous in crystallization like talc and chlorite.[1] This is so far true that a silicate having the centesimal composition of serpentine assumes a phylloid type, as seen in thermophyllite and in marmolite, but it also takes on a prismatic

V. *Tribe* 4. PROTOPHYLLOID.

SPECIES.	FORMULA.	P	D	V	CRYS.
Thermophyllite.	$(mg_3si_4)o_7 + 2aq$ - - - - -	15·33	2·61	5·87	—— ?
Marmolite. - -	$(mg_3si_4)o_7 + 2aq$ - - - - -	15·33	2·41	6·31	—— ?
Talc. - - - -	$(mg_4si_{10})o_{14} + 1aq$ - - - -	15·95	2·70	5·90	Orthorh.
Talc. - - - -	$(mg_3si_9)o_{12} + \frac{3}{4}aq$ - - - - -	15·82	2·60	6·07	Orthorh.

fibrous type in chrysotile and in picrolite, silicates of unlike density already mentioned in § 65, and is moreover found as an amorphous colloid species included in the next tribe, that of the Ophitoids, of which it may be regarded as the type.

Tribe 5.—OPHITOIDS.

§ 67. In considering this tribe we begin by noting certain differences in composition and in specific gravity among the magnesian silicates, which (besides thermophyllite, marmolite, picrolite and chrysotile) have hitherto been grouped under the name of serpentine. A density of from 2·60 to 2·70 is generally assigned to this silicate, but bowenite, according to the analysis of J. Lawrence Smith and Brush, is a nearly pure serpentine, with a density of 2·69-2·78, and a hardness of 5·5-6·0. Retinalite, a clearly marked ophitoid or amorphous species, which includes much of the serpentine of the Laurentian limestones, is a very pure magnesian silicate, distinguished from ordinary serpentine by its lower density, and its larger proportion of water, which, from several analyses, the writer found to be over fifteen hundredths. The specific gravity of retinalite is 2.36-2.38, or nearly that assigned to the phylloid species, marmolite. The name of serpentine may perhaps be retained for the amorphous silicate with density 2·6-2.7, which must be distinguished from retinalite, as well as from chrysotile, from picrolite, from thermophyllite, and from marmolite. This last requires further study, as does likewise bowenite, which merits particular notice from its superior density and hardness, and requires optical examination.

§ 68. Following serpentine and retinalite in Table VI, are deweylite and genthite—the latter a niccoliferous ophitoid, as chrysocolla is a cupric one. With the latter are placed the bisilicates, aphrodite and cerolite, which last appears to have the volume of retinalite and of deweylite. After these we have placed spadaite, as also renssellaerite or pyrallolite (which is perhaps a compact phylloid rather than an ophitoid), and sepiolite. Alongside of this, a position has been conjecturally assigned to glauconite, as not improbably a ferrous potassic ophitoid, of which a large part of the iron has subsequently passed into the ferric condition.

[1] System of Mineralogy, 5th Ed., p. 465.

§ 69. The significance of this tribe of amorphous hydrous silicates in mineralogy will be more apparent when we come to study the corresponding tribes among the other two suborders of silicates, and still further among the non-silicated oxyds. In each of these we find a group of compounds which, although occasionally assuming crystalline form in parallel tribes, require for their crystallization conditions which are not always present. The particular silicate of magnesia which constitutes serpentine, though occasionally crys-

VI. *Tribe* 5. OPHITOID.

SPECIES.	FORMULA.	P	D	V	REMARKS.
Serpentine. - -	$(mg_3si_4)o_7 + 2aq$ - - - - -	15·33	2·65	5·78	
Retinalite. - -	$(mg_3si_4)o_7 + 2\frac{1}{2}aq$ - - - - -	15·00	2·40	6·16	
Deweylite. - -	$(mg_2si_3)o_5 + 3aq$ - - - - -	14·00	2·25	7·60	
Genthite. - - -	$(ni_2si_3)o_5 + 3aq$ - - - - -	18·25	2·40	7·60	
Aphrodite. - -	$(mg_1si_2)o_3 + \frac{3}{4}aq$ - - - - -	15·13	2·21	6·84	
Cerolite. - - -	$(mg_1si_2)o_3 + 1\frac{1}{2}aq$ - - - - -	14·11	2·30	6·13	
Chrysocolla. - -	$(cu_1si_2)o_3 + 2aq$ - - - - -	17·52	2·24	7·82	
Spadaite. - - -	$mg_5si_{12})o_{17} + 4aq$ - - - - -	15.04	——?	....	
Rensselaerite. -	$(mg_4si_{10})o_{14} + 1aq$ - - - - -	15·95	2·70	5·90	Perhaps a compact phylloid.
Sepiolite. - - -	$(mg_1si_3)o_4 + 1aq$ - - - - -	14·80	——?	....	
Glauconite. - -	- - - - - - - - - - - - -	....	....	....	See § 41.

tallizing in hydrous forms, as in thermophyllite and chrysotile, appears incapable of forming an anhydrous species like the more and the less basic silicates of the same base which readily crystallize, such as chrysolite and enstatite. Hence we often find the hydrous colloid, serpentine, still associated with the one or the other of these, into a mixture of which it is resolved when its dehydration and fusion are effected by heat.

Tribe 6.—ZEOLITOID.

§ 70. The sixth tribe in our system, being the first in the suborder of the protopersilicates, has been designated Zeolitoid for the reason that it includes, and is chiefly represented by that large family of silicates familiarly known as zeolites, which have been aptly described as hydrated feldspars. These are double silicates of a protoxyd base and alumina, the atomic ratio between the two being 1 : 3, and the protoxyds essentially lime and alkalies, occasionally with baryta and strontia,—magnesia being for the most part absent or found only in traces. The proportion of silica varies from that of thomsonite, which gives the ratios 1 : 3 : 4, to stilbite and related species with 1 : 3 : 12. The water is also subject to great variations, and is held with different degrees of force—some species, such as laumontite and chabazite, parting with a portion in dry air at ordinary or slightly elevated temperatures, while others are much more stable. The intumescence before the blowpipe-flame, which is characteristic of many species of this family, and which suggested the name of "zeolite," would seem to indicate that a partial melting of these takes place before the complete expulsion of water, or in other words, that the silicate fuses in its water of crystallization. The zeolites are attacked by acids with pectisation, and are but little

condensed, having relatively high values for V. We have given, in the accompanying table, No. VII, some of the more important species of this large family. Pollucite, from the analysis of Rammelsberg, is a zeolite in which two-thirds of the protoxyd base is oxyd of cæsium.

§ 71. In the same tribe of Zeolitoids we place several other hydrous silicates, which are distinguished from the zeolites by presenting different ratios between the protoxyd and sesquioxyd bases. Of these the most notable species is prehnite, which, among the secre-

VII. *Tribe* 6. ZEOLITOID.

SPECIES.	FORMULA.	P	D	V	CRYS.
Xanthorthite.	$(m_1al_1si_2)o_4+2aq$ - $(m=ce, fe)$	....	2·90	....	Clinorh.
Prehnite.	$(ca_2al_3si_6)o_{11}+1aq$	17·11	2·95	5·80	Orthorh.
Hamelite.	$(m_1al_2si_3)o_6+1aq$ - $(m=mg, fe, na)$	....	....	....	——?
Catapleiite.	$(m_1zr_2si_6)o_9+2aq$	18·91	2·80	6·75	Hexag.
Cancrinite.	$(na_6al_{18}si_{27})o_{51}+3c_1ca_1o_3+4\frac{1}{2}aq$	....	....	....	Hexag.
Thomsonite.	$(m_1al_3si_4)o_8+2\frac{1}{2}aq$ - $(m=ca\frac{1}{4}na\frac{3}{4})$	15·57	2·38	6·54	Orthorh.
Gismondite.	$(ca_1al_3si_{4\cdot 50})o_{8\cdot 50}+4\frac{1}{2}aq$	14·38	2·26	6·35	Orthorh.
Natrolite.	$(na_1al_3si_6)o_{10}+2aq$	15·83	2·25	7·03	Orthorh.
Scolecite.	$(ca_1al_3si_6)o_{10}+3aq$	15·08	2·40	6·28	Clinorh.
Mesolite.	$(m_1al_3si_6)o_{10}+3aq$ - $(m=ca\frac{2}{3}na\frac{1}{3})$	15·14	2·40	6·31	Clinorh.
Levynite.	$(ca_1al_3si_6)o_{10}+4aq$	14·57	2·16	6·74	Rhombo.
Pollucite.	$(m_1al_3si_8)o_{12}+1aq$ - $(m=cs\frac{2}{3}na\frac{1}{3})$	21·84	2·90	7·53	Isomet.
Analcite.	$(m_1al_3si_8)o_{12}+2aq$	15 71	2·29	6·86	Isomet.
Eudnophite.	$(na_1al_3si_8)o_{12}+2aq$	15·71	2·27	6·92	Orthorh.
Laumontite.	$(ca_1al_3si_8)o_{12}+4aq$	14·68	2.30	6·38	Clinorh.
Herschelite.	$(m_1al_3si_8)o_{12}+5aq$ - $(m=na\frac{3}{4}k\frac{1}{4})$	14·70	2·06	7·13	Orthorh.
Phillipsite.	$(m_1al_3si_8)o_{12}+5aq$ - $(m=ca\frac{2}{3}na\frac{1}{3})$	14·70	2·20	6·68	Orthorh.
Chabazite.	$(ca_1al_3si_8)o_{12}+6aq$	14·05	2·19	6·41	Rhombo.
Gmelinite.	$(ca_1al_3si_8)o_{12}+6aq$ - $(m=ca\frac{1}{2}na\frac{1}{2})$	14·11	2·17	6·50	Rhombo.
Faujasite.	$(m_1al_3si_9)o_{13}+9aq$ - $(m=na\frac{1}{2}ca\frac{1}{2})$	12·75	1·92	6·64	Isomet.
Hypostilbite	$(ca_1al_3si_9)o_{13}+6aq$	14·10	2·20	6·40	——?
Harmotome.	$(m_1al_3si_{10})o_{14}+5aq$ - $(m=ba\frac{9}{10}na\frac{1}{10})$	16·61	2·45	6·77	Orthorh.
Epistilbite.	$(ca_1al_3si_{12})o_{16}+5aq$	14 33	2·25	6·37	Orthorh.
Brewsterite.	$(m_1al_3si_{12})o_{16}+5aq$ - $(m=sr\frac{2}{3}na\frac{1}{3})$	16·02	2·45	6·54	Clinorh.
Stilbite.	$(ca_1al_3si_{12})o_{16}+6aq$	14·23	2·20	6·46	Orthorh.
Heulandite.	$(ca_1al_3si_{12})o_{16}+5aq$	14·33	2·20	6·51	Clinorh.
Edingtonite.	$(ba_1al_4si_7)o_{12}+4aq$	17·81	2.71	6·57	Tetrag.
Sloanite.	$(ca_1al_5si_7)o_{13}+3aq$	15·31	2·44	6·27	Orthorh.
Forestite.	$(ca_1al_6si_{12})o_{19}+6aq$	14·56	2·40	6·06	Orthorh.

tions of basic rocks, frequently accompanies the zeolites. The species here called hamelite, was described by the writer many years since as a crystalline hydrous silicate of ferrous oxyd, magnesia and soda, filling the pores of a palæozoic crinoid,[1] while catapleiite is a zirconic zeolitoid, in which zirconia takes the place of alumina. Here also we have placed xanthorthite, a hydrous species which, by its composition and its low density,

[1] Amer. Jour. Science, 1871, i. 379.

is widely separated from the anhydrous dense adamantoid orthite or allanite, to be noticed farther on. While the species just noticed are more protobasic than the zeolites, there are not wanting examples of zeolitoid species less protobasic than these. Such is the curious barytic silicate, edingtonite, to which analysis assigns for protoxyds and alumina the ratio, 1 : 4; sloanite, zeolitic in habit, with a ratio of 1 : 5, and forestite, a species closely resembling stilbite, to which is given the ratio, 1 : 6. The hydrous carbo-silicate, cancrinite, and the sulphatosilicate, ittnerite, which properly belong to the zeolitoids, will be noticed under the next tribe in § 83, 84.

Tribe 7.—Protoperspathoids.

§ 72. We have next to consider the Protoperspathoids, which include, beside the feldspars and the scapolites, a number of other species of double silicates, chiefly aluminous. The species of this tribe are distinguished from the preceding by their higher density, superior hardness, and greater resistance to acids; since, while the whole of the zeolites and zeolitoids are decomposed thereby, generally with pectisation, only the more basic of the protoperspathoids are thus attacked.

The feldspars, like the zeolites, have the atomic ratio between the protoxyds and alumina represented by 1 : 3, the silica in both being subject to the same variations. As in the zeolites, the protoxyd bases are alkalies and lime, rarely with baryta, while magnesia and ferrous oxyd are but exceptionally present. Unlike the zeolites they are anhydrous, or contain occasionally one or two hundredths of water.

§ 73. The feldspar family includes, first, the feldspars proper, represented by the anorthite-albite genus; secondly, orthoclase, microcline and hyalophane, near which may be placed nephelite and paranthite; and thirdly, leucite. These distinctions, as may be seen from the table, No. VIII, correspond to different values of V. Iolite, a ferromagnesian feldspathide, though peculiar in composition, and differing in crystallization from the feldspars, agrees in volume with anorthite and albite. Eucryptite, which has the formula of a lithia-anorthite, seems to differ from these in possessing a more condensed molecule. The possibility of a more siliceous feldspar than albite, corresponding to the supposed krablite of Forchammer, with its ratios of 1 : 3 : 24, should not be overlooked.

The specific gravities of orthoclase and of microline show for these species a considerable greater atomic volume than for albite and its related species, a fact which was noted in 1854 by the writer as a reason for referring orthoclase to a less condensed molecule than these (§ 30). Nephelite also shows a volume near that of orthoclase, as does the baryta-potash feldspar, hyalophane, which has the same general atomic formula as andesite; while leucite, with the same atomic formula, has a still larger volume.

§ 74. The history of that feldspar genus which includes anorthite and albite, has been noticed at length in the second part of this paper, where was discussed the view that the feldspars intermediate in composition between these, may be mixtures of two homœomorphous species. The notion was there expressed that while such mixtures are, as was long since suggested, not uncommon in nature, many, if not all of these intermediate feldspars are definite species (§ 32). The careful studies of the late George W. Hawes have thrown much light on this subject by showing that in similar and apparently iden-

tical rocks the feldspathic element may be represented by two associated feldspars of the same genus,—in one case apparently, anorthite and albite; in another, labradorite and andesite. The diabase which along the Atlantic border of North America is found irrupted among mesozoic strata, from Nova Scotia to North Carolina, is singularly uniform in chemical composition and in density, and by many observers has been found to be

VIII. *Tribe* 7. PROTOPERSPATHOID.

SPECIES.	FORMULA.	P	D	V	CRYS.	REMARKS.
Melilite.	$(ca_2 m_1 si_3)o_6$ - $(m = al_{\frac{1}{2}} fi_{\frac{1}{2}})$	19·96	3·10	6·44	Tetrag.	
Eudialyte.	$(m_4 zr_2 si_{12})o_{18}$ - $(m = na_{1\cdot5} ca_{1\cdot5} fe_{1\cdot0})$	....	3·00	....	Rhombo.	Chlorosilicate.
Wöhlerite.	$(m_3 zr_2 si_5)o_{10}$ - $(m = na_{0\cdot6} ca_{2\cdot2} fe_{0\cdot2})$	....	3·41	....	Clinorh.	Niobosilicate.
Humboldtilite.	$(ca_3 al_2 si_5)o_{10}$	19·30	2.90	6·65	Tetrag.	
Ilvaite.	$(m_3 fi_2 si_5)o_{10}$ - $(m = fe_{\frac{2}{3}} ca_{\frac{1}{3}})$	22·82	3·71	6·15	Orthorh.	
Gehlenite.	$(ca_{1\cdot0} m_{1\cdot0} si_{1\cdot3})o_{3\cdot3}$ - $(m = al_{\frac{5}{6}} fi_{\frac{1}{6}})$	19·98	3·06	6.52	Tetrag.	
Sarcolite	$(ca_1 al_1 si_2)o_4$	18·75	2·93	6·40	Tetrag.	
Milarite.	$(m_1 al_1 si_8)o_{10}$ - $(m = ca_{0\cdot8} k_{0\cdot2})$	17·00	2·59	6·56	Orthorh.	
Barylite.	$(ba_2 al_3 si_7)o_{12}$	25·95	4·03	6·38	—— ?	
Meionite.	$(ca_4 al_9 si_{12})o_{25}$	17·80	2·74	6·49	Tetrag.	Chlorosilicates with lime and alkalies, § 76.
Wernerite.	$(m_4 al_9 si_{16})o_{29}$	17·41	2·70	6·44	Tetrag.	
Ekebergite.	$(m_4 al_9 si_{18})o_{31}$	....	2·74	....	Tetrag.	
Mizzonite.	$(m_4 al_9 si_{21})o_{34}$	17·23	2·62	6·57	Tetrag.	
Dipyre.	$(m_4 al_9 si_{24})o_{37}$	....	2·64	....	Tetrag.	
Marialite.	$(m_4 al_9 si_{36})o_{49}$	16·57	2·57	6·44	Tetrag.	
Sodalite.	$(na_4 al_9 si_{12})o_{24} cl_1$	19·38	2·30	8·42	Isomet.	Chlorosilicate.
Nosite.	$(na_1 al_3 si_4)o_8 + \frac{1}{3} na_1 s_1 o_4$	20·28	2·40	8·25	Isomet.	Sulphatosilicate.
Hauyne.	$(na_1 al_3 si_4)o_8 + \frac{2}{3} ca_1 s_1 o_4$	21·57	2·50	8·62	Isomet.	Sulphatosilicate.
Lapis lazuli.	- - - - - - - - - - - -	....	2·45	....	Isomet.	Sulphosilicate.
Leucite.	$(k_1 al_3 si_8)o_{12}$	18·16	2·56	7·09	Isomet.	
Hyalophane.	$m_1 al_3 si_8)o_{12}$ - $(m = ba_{\frac{1}{2}} k_{\frac{1}{2}})$	19·39	2 80	6·92	Clinorh.	
Orthoclase.	$(k_1 al_3 si_{12})o_{16}$	17·37	2.54	9·83	Clinorh.	
Microcline.	$(k_1 al_3 si_{12})o_{16}$	17·37	2·54	6·83	Anisom.	
Nephelite.	$(na_1 al_3 si_{4\cdot5})o_{8\cdot5}$	17·58	2·66	6·66	Hexag.	
Paranthite.	$(ca_1 al_3 si_4)o_8$	17·37	2·75	6·32	Tetrag.	
Eucryptite.	$(li_1 al_3 si_4)o_8$	15·81	2·67	5·95	Hexag.	
Anorthite.	$(ca_1 al_3 si_4)o_8$	17·37	2·75	6·32	Anisom.	
Barsowite.	$(ca_1 al_3 si_5)o_9$	17·11	2·73	6·27	—— ?	
Labradorite.	$(m_1 al_3 si_6)o_{10}$ - $(m = ca_{\frac{3}{4}} na_{\frac{1}{4}})$	16·97	2·70	6·32	Anisom.	
Andesite.	$(m_1 al_3 si_8)o_{12}$ - $(m = ca_{\frac{1}{2}} na_{\frac{1}{2}})$	16·70	2·68	6·23	Anisom.	
Oligoclase.	$(m_1 al_3 si_9)o_{13}$ - $(m = na_{\frac{3}{4}} ca_{\frac{1}{4}})$	16·61	2·65	6.26	Anisom.	
Albite.	$(na_1 al_3 si_{12})o_{16}$	16·37	2·62	6·24	Anisom.	
Iolite.	$(m_1 al_3 si_5)o_9$ - $(m = mg_{\frac{2}{3}} fe_{\frac{1}{3}})$	16·87	2·67	6·31	Hexag.	
Petalite.	$(li_1 al_4 si_{20})o_{25}$	15·32	2·42	6·33	Clinorh.	

essentially an admixture of pyroxene, magnetite, and a triclinic feldspar which has been represented as labradorite, and with which the composition of the rock as a whole accords.[1] Hawes, however, observed that this diabase as found at West Rock, New Haven,

[1] See Dana, Amer. Jour. Science, vi. 194.

Connecticut, includes anorthite, of which the larger feldspathic grains are composed, and showed by calculation that the rock as a whole might contain in 100.00 parts, anorthite 15.52, albite 22.16, orthoclase 2.32, the remainder being pyroxene with a little menaccanite and magnetite, apatite and some combined water being present.

A farther attempt to determine the composition of the feldspathic element in a similar diabase was then made with that from the Palisades of the Hudson at Jersey City. The feldspar from this, separated from the other ingredients by the aid of a solution of potassio-mercuric iodid of specific gravity 2.90, was, by a similar solution of 2.69, clearly divided into two portions, a lighter or a heavier, which gave by analysis respectively the composition very nearly of andesite and of labradorite,—the atomic ratios for the first portion being 1 : 3 : 8 and for the second 1 : 3 : 6½, without including 0.59 of water in the first, and 1.06 in the second. Hawes reasons with regard to these facts, that slight variations in the conditions of cooling in a fused mass might determine either the separation of the feldspathic element as the two species, anorthite and albite; or the formation of one or more intermediate species. He adds, with rare insight, "an exquisite balance of composition and circumstance would be necessary to crystallize such a rock with a single feldspar," and conceives that we have evidence that massive rocks are rarely simple as regards their feldspathic element.[1] Meanwhile it will remain to be decided for each individual case, whether a feldspathic material intermediate in composition between albite and anorthite is an integer, or an admixture of two integers, which may themselves be either the terms of the series or integral intermediate species.

Mention should here be made of petalite, a species in many respects closely related to the feldspars, but presenting the ratios, 1 : 4 : 20. As regards the proportion between protoxyds and alumina, it is important as the one spathoid which corresponds with the rare and less protobasic zeolitoids; while if krablite be rejected, petalite is the most siliceous species known. Its atomic volume is identical with that of anorthite, albite and iolite.

§ 75. The scapolites apparently constitute a single genus of silicates which approaching in composition, hardness and density the feldspars, were, from an early time, compared with them, so that when, in 1854, the writer attempted to generalize the notion of Von Waltershausen as to crystalline intermixtures in the intermediate feldspars, he extended a similar view to the scapolites, as already shown (§ 31). The ratio between the protoxyds and alumina in the scapolites has, until recently, generally been regarded as 1 : 2, and the writer, in 1863, in farther discussing the relations of the scapolites, described them as a group of which the extreme terms were meionite, with the ratios 1 : 2 : 4, and dipyre with 1 : 2 : 6; including intermediate species which might be regarded as crystalline admixtures of the two isomorphous silicates.

Very recently, however, Tschermak has reviewed the scapolites,[2] and has reached the conclusion that the atomic ratio of the protoxyds to alumina therein is not 1 : 2 as hitherto supposed, but 4 : 9 or 1 : 2¼. In other words, if we would compare them with the feldspars by multiplying their atomic formulas so as to get in each the same amount of silica, while anorthite becomes $(ca_3al_9si_{12})o_{24}$, meionite is not $(ca_4al_8si_{12})o_{24}$, but

[1] Proc. U. S. National Museum for 1881, pp. 129–134.

[2] Monatshefte fur Chemie, Dec., 1883.

according to Tschermak $(ca_4si_9si_{12})o_{25}$: that is to say, the ratio of al : si in the two species remaining unchanged, there is an addition of an atom of ca_1o_1. But dipyre, which was made the other term of the series, is no longer the most silicic scapolite. This, in accordance with the former notation, would be 1 : 2 : 9, or, multiplying and correcting to bring the formula into accordance with Tschermak's conclusion, 4 : 9 : 36. Reverting to the simplest atomic formulas, the two scapolites which form the extremes of our series differ from anorthite and from albite in containing each one third of an atom additional of protoxyd, being $(ca_1al_3si_4)o_{12} + \frac{1}{3}m_1o_1$ and $(m_1al_3si_{12})o_{16} + \frac{1}{3}m_1o_1$. Multiplying by three, to compare with the formula given above for meionite, we have, for this last and most silicic scapolite, $(m_4al_9si_{36})o_{49}$ which represents the marialite of Pianura, described by Von Rath.

§ 76. The scapolites, however, contain more or less chlorine, as observed by Adams, and by others. Found in small quantities in meionite, it equals in some examples 2·48 per cent., though apparently absent in marialite. The theoretical chloriferous scapolite is, however, according to Tschermak, a marialite in which, with the above formula, one atom of oxygen is replaced by chlorine (4·20 per cent.), or in other words is albite $(m_1al_3si_{12})o_{16} + \frac{1}{3}na_1cl_1$, the additional basic element being here chlorid instead of oxyd. In the scapolites, as in the feldspars, in ascending the series, there appears a progressive increase in alkalies, which gradually replace the lime, until in mizzonite and marialite we find considerable soda and some potash. A general decrease in density is at the same time apparent, but more accurate determinations of this factor are needed for the scapolites. We have in the accompanying table revised the atomic formulas so as to correspond with the ratio of 4 : 9 for protoxyds and alumina.

The intermediate scapolites of the meionite-marialite series are imagined by Tschermak to be, not as proposed by Von Waltershausen and myself, crystalline intermixtures, but binary combinations in different proportions of the two silicates, meionite and marialite. He notes (1) compounds holding one equivalent of marialite to two of meionite, which are almost or completely soluble in acids; (2) compounds with one of meionite to two of marialite, incompletely soluble; and (3) compounds with less than the latter proportion of marialite, insoluble in acids. This variation in solubility will in the chemist's eyes, be, as already shown (§ 32), a reason for rejecting the notion that they are admixtures, while he will at the same time repudiate the attempt to perpetuate in their formulas the dualistic notions of a former day. These intermediate scapolites like the feldspars, labradorite and oligoclase, and the various zeolites between thomsonite and stilbite, must be regarded as distinct species.

§ 77. In close relation to the scapolites comes a remarkable group comprising sodalite, nosite and hauÿne. Sodalite has the atomic formula of a chlorinated soda-meionite, being $(na_4al_9si_{12})o_{24}cl_1$. Nosite is a similar species, in which the chlorine is replaced by oxysulphion, while hauÿne is another species, in which the proportion of protoxyd base is greater than in these, giving the ratio, 5 : 9 : 12. The relations of these various species to anorthite and to each other, may, if anorthite be written $(ca_3al_9si_{12})o_{24}$, be represented as follows: meionite, $(ca_3al_9si_{19})o_{24} + ca_1o_1$; sodalite, $(na_3al_9si_{12})o_{24} + na_1cl_1$; nosite, $(na_3al_9si_{12})o_{24} + na_1s_1o_4$; hauÿne, $(na_3al_9si_{12})o_{24} + 2ca_1s_1o_4$. Both of these sulphatic species contain also small amounts of chlorine. Ittnerite is a hydrous species related to these, but containing a smaller proportion of sulphates than either, and, like the associated scolopsite, requires

farther study. Lapis lazuli, a sulphatic and sulphuretted species, the composition of which is not accurately determined, is apparently related to the sodalite group. Notwithstanding the resemblance in composition between these silicates and the scapolites, they differ very widely from the latter in degree of condensation; for, while the scapolites approach the feldspars in volume, the species of the sodalite group give a higher value for V than leucite, or indeed than any other known natural silicates.

§ 78. The relations between anorthite, meionite and the silicates, sodalite, nosite and haüyne, which we include under the general name of the sodalite group, help us to understand the nature of cancrinite, and its relation to nephelite. This latter species, which has an atomic volume near that of orthoclase, is a little more siliceous than anorthite, and its atomic formula, $(na_{1\cdot0}al_{3\cdot0}si_{4\cdot5})o_{8\cdot5}$, may be multipled by six, making it $(na_{6}al_{18}si_{27})o_{51}$, to show more simply its relation to cancrinite. This mineral which was formerly imagined to be an admixture of carbonate of lime with a hydrated nephelite, appears from recent studies to be an integral carbosilicate, comparable wiih the sulphatosilicates and the chlorosilicates of the sodalite and scapolite groups. The cancrinite of Miask, with a specific gravity of 2·45, as analyzed by Rauff, is represented by $(na_{6}al_{18}si_{27})o_{51} + 3c_{1}ca_{1}o_{4} + 4\frac{1}{2}aq$ ($c = 6$), while the cancrinite of Ditró, according to Koch, contains a portion of potash, and offers slight variations from the above formula in the amounts of lime and silica. This hydrous carbosilicate, like the hydrous sulphatosilicate ittnerite, will find a place among zeolitoids rather than among spathoids.

§ 79. Coming next to more highly protobasic spathoids, we have the remarkable barytic species, barylite, presenting the anomaly of a highly basic silicate having the ratios, 2 : 3 : 7, and the volume of the feldspars and scapolites, which is said to resist the action of acid. Milarite, sarcolite and gehlenite present an interesting group in which, the ratio of protoxyd to alumina being 1 : 1, there is a great variation in the proportion of silica from, 1 : 1 : 8 in milarite, to 1 : 1 : 2 in sarcolite, and 1 : 1 : $1\frac{1}{3}$ in gehlenite. In the native gehlenite a small portion of alumina appears to be replaced by ferric oxyd, but the artificial gehlenite from furnace-slags, analyzed by Percy, is without iron, and is an oxysulphid containing 1.50 per cent. of sulphur. Melilite, a spathoid silicate, is also found as a furnace-product, and, according to Percy, contains a variable amount of sulphur, equal in one case to 1.62 per cent., while the native melilite is destitute of sulphur. Under this name are, perhaps, confounded two distinct species. The artificial melilite, which approaches the so-called humboldtilite in composition, has an atomic formula near to $(ca_{3}al_{2}si_{5})o_{10}$, and a volume almost identical with gehlenite, while the native melilite is more nearly $(ca_{2}al_{1}si_{3})o_{6}$. Similar atomic ratios to the last, as regards the bases, are presented by eudialyte, a zirconic spathoid, the composition of which is nearly represented by $(m_{4}zr_{2}si_{12})o_{18}$, and which contains much lime and soda, with a little chlorine. Wöhlerite, another zirconic spathoid, containing some niobic acid replacing silica, has the atomic formula $(m_{3}zr_{2}si_{5})o_{10}$, the the ratio between the protoxyd-bases and zirconia being, as in the artificial melilite, 3 : 2. In these two species we have examples of the complete replacement of alumina by zirconia. In melilite as analysed by Damour, and also in gehlenite, a partial replacement of alumina by ferric oxyd is shown, and a complete substitution of this kind appears in ilvaite, a spathoid species having the ratios of wöhlerite, with a density of 3.71. The higher specific gravity of 4.00 observed for some examples of ilvaite, may show a related species, or more probably, as suggested by Dana, may be due to an admixture of göthite or other iron-oxyd.

Tribe 8.—Protoperadamantoids.

§ 80. We come next to the Protoperadamantoids, a very important tribe. Beginning with the most highly protobasic species, we find in the first line, pargasite, which we have already noticed as an aluminous amphibole, connecting the protopersilicates with the preceding suborder. With this we place keilhauite, a titaniferous silicate, which, like titanite, is attacked by hydrochloric acid, a character not common to adamantoids, save in the more highly basic species of the first suborder, and already noticed (§ 57). In keilhauite, a part of the alumina is replaced by ferric oxyd, and in the titaniferous schorlomite, which is also attacked by the acid, and has a ratio very near to keilhauite, the whole of the sesquioxyd base is ferric, while a partial replacement of the same kind is

IX. *Tribe* 8. Protoperadamantoid.

Species.	Formula.	P	D	V	Crys.	Remarks.
Pargasite. - - -	$(m_2al_1si_3)o_6$ - $(m = ca_{0\cdot5}mg_{1\cdot5})$ -	17·66	3·05	5·79	Clinorh.	
Keilbauite. - -	$(m_2\mathit{m}_1si_4ti_3)o_{13}$ - $(m = ca_{1\cdot5}yt_{0\cdot5})$	20·63	5·57	5·57	Clinorh.	Titanosilicate.
Schorlomite. - -	$(ca_4fi_3si_6ti_4)o_{17}$ - $[(\mathit{m} = al_{\frac{2}{3}}fi_{\frac{1}{3}})$	21·41	3·80	5.64	——?	Titanosilicate.
Idocrase. - - -	$(ca_3al_2si_3)o_{10}$ - - - - - - - -	19·33	3·40	5·68	Tetrag.	
Garnet. - - -	$(ca_1al_1si_2)o_4$ - - - - - - - -	18·79	3·50	5·37	Isomet.	
Allanite. - - -	$(m_1al_1si_2)o_4$ - $(m = ce_{\frac{1}{3}}ca_{\frac{1}{3}}fe_{\frac{1}{3}})$	20·75	3·80	5·46	Clinorh.	
Ægirite. - - -	$(m_3fi_3si_{12})o_{13}$ - $(m_3 = na_1ca_1fe_1)$	19·72	3·58	5·50	Clinorh.	
Beryl. - - - -	$(be_3al_2si_{12})o_{18}$ - - - - - - -	14·91	2·70	5·52	Hexag.	See § 80.
Euclase. - - -	$(be_2al_3si_4)o_9 + 1aq$ - - - - -	14·50	3.10	4·69	Clinorh.	
Arfvedsonite. -	$(m_2fi_3si_{10})o_{15}$ - $(m_2 = na_1ca_1)$ -	19·80	3·59	5·50	Clinorh.	
Ardennite. - -	$(mn_2al_3si_4)o_9 + 1aq$ - - - -	18·48	3·62	5·10	Orthorh.	Vanadosilicate.
Axinite. - - -	$(ca_1\mathit{m}_2si_{3\cdot5}bo_{0\cdot5})o_7$ - $(\mathit{m}_2 = al_{\frac{1}{3}}fi_{\frac{2}{3}})$	18·14	3·27	5·44	Anisom.	Borosilicate.
Epidote. - - -	$(ca_1\mathit{m}_2si_3)o_6 + \frac{1}{3}aq$ - $(\mathit{m}_2 = al_{\frac{1}{2}}fi_{\frac{2}{3}})$	18·36	3·40	5·40	Clinorh.	
Zoisite. - - - -	$(ca_1al_2si_3)o_6$ - - - - - - - -	17·36	3·35	5·18	Orthorh.	
Jadeite. - - -	$(na_1al_2si_6)o_9$ - - - - - - - -	17·22	3·32	5·18	——?	
Acmite. - - -	$(m_2fi_4si_{12})o_{18}$ - $(m_2 = na_{1\cdot5}fe_{0\cdot5})$ -	19·50	3·53	5.52	Clinorh.	
Spodumene. - -	$(li_1al_4si_{10})o_{15}$ - - - - - - - -	15·53	3·18	4·88	Clinorh.	
Sapphirine. - -	$(mg_1al_4si_1)o_6$ - - - - - - - -	17·16	3·48	4·93	Orthorh.	
Staurolite. - -	$(fe_1al_4si_{2\cdot5})o_{7\cdot5} + \frac{1}{3}aq$ - - - -	18·44	3·75	4·91	Orthorh.	
Coronite. - - -	$(m_1al_3si_5)o_9$ - - - - - - - -	16·36	3·05	5·36	Rhombo.	
Schorlite. - - -	$(m_1al_4si_6)o_{11}$ - - - - - - - -	16·68	3·10	5·38	Rhombo.	Oxyfluorids,
Aphrizite. - - -	$(m_1al_6si_8)o_{15}$ - - - - - - - -	17·24	3·20	5·38	Rhombo.	borosilicates;
Indicolite. - -	$(m_1al_9si_{12})o_{22}$ - - - - - - - -	16·42	3·08	5·33	Rhombo.	see § 86.
Rnbellite. - - -	$(m_1al_{12}si_{15})o_{28}$ - - - - - - - -	16·06	3·00	5·35	Rhombo.	

observed in some varieties of idocrase. Next in order comes garnet, including many species, in some of which ferric or chromic oxyd replaces more or less completely alumina; while the protoxyd base is either wholly lime or in part magnesia or manganous or ferrous oxyd. The single example of garnet given in Table IX is that of a pure lime-alumina species examined by the writer. We have placed allanite near to garnet for the reason that, according to Rammelsberg, the best determinations give approximately the garnet-ratio, 1 : 1 : 2, rather than that of epidote, 1 : 2 : 3, notwithstanding that the species is

homœomorphous with epidote, and is often spoken of as a cerium-epidote, to the atomic ratios of which some analyses apparently conform. A farther study of the group of minerals commonly included under the name of allanite or orthite is required. The great differences in density; the facts that some resist the action of acids, while others are attacked thereby, that some are anhydrous, while others are more or less highly hydrated,—all lead to the conclusion that several species are here included. We have already separated therefrom the so-called xanthorthite, as a cerium-zeolitoid, and it is probable that besides one or two hydrous species, and a true adamantoid, there will be found at least one intermediate spathoid species. The alumina in the allanites is often in part replaced by ferric oxyd. A pure alumina-allanite, with the garnet-ratio, in which the protoxyd bases are equally divided between cerous and ferrous oxyds and lime, gives the value for V as calculated in the table.

§ 81. The glucinic species, beryl, is generally regarded as having the atomic ratio, 1 : 1 : 4, and has a volume near to garnet. The late analyses of Penfield[1] have, however, shown that beryl contains a small and variable amount of alkalies replacing glucina, besides a portion of water varying from 1.50 to 2.50 per cent. He finds that the composition of the mineral is best expressed by the more complex formula $(gl_5al_6si_{22})o_{33}+4aq_1$, a change which, however, affects very slightly the values calculated in the table, that of V being thereby changed to 5.48.

Euclase, though closely related to beryl in composition and, like it, hydrated, shows a much greater condensation. Ardennite, which presents the atomic ratio of euclase, and is also hydrated, is essentially a manganese-alumina silicate with some magnesia and lime, besides a small portion of vanadate, more or less completely replaced, in some instances, by arsenate. These latter elements are probably comparable, in their relations, to the sulphates in nosite and hauÿne. Abstracting them, we find for the silicates essentially the formula given in the table, which can, however, only be regarded as approximate.

The species axinite is noticable for containing some boric oxyd. The formula which we have deduced in the table, in which one eighth of the silica is thus replaced, and one third of the sesquioxyd is ferric, is, also, but an approximation. The composition of this, like that of beryl, of ardennite and a great number of polysilicates, cannot be accurately represented by such simple formulas, which, however, suffice to show, with sufficient exactness, the atomic volume and the place of the species in the system.

§ 82. We come next to epidote, the composition of which presents many variations, due in part to a greater or less replacement of alumina by ferric oxyd, and in the so-called piedmontite, by manganese sesquioxyd. The presence of a small amount of water, equal to about 2.0 per cent, seems, as in beryl, euclase and ardennite, to be essential to the composition of the species. The atomic formula for a pure lime-alumina epidote, as imagined by Rammelsberg, is $(ca_1al_2si_3)o_6$; but such an epidote is unknown in nature, and we have, for the purpose of determining the volume of the species, selected a variety in which one third of the sesquioxyd is ferric. The formula, moreover, takes no note of the small amount of water present in the species.

Zoisite is essentially a lime-alumina silicate, seldom containing over five or six

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[1] Amer. Jour. Science, 1884, xxviii. 25.

hundredths of ferric oxyd, and often traces only. It is not improbable that the true ratio of the protoxyd and sesquioxyd bases in these two species, as in meionite, with which they have been paralleled, may be represented by 4 : 9, rather than by 1 : 2. We note next the more siliceous jadeite, whose formula, as already pointed out (§ 38), is related to that of zoisite as dipyre is to meionite (§ 31). While zoisite is essentially a calcic species, seldom containing over three or four hundredths of soda, jadeite is sodic, and it appears, like the compact zoisite or saussurite, to be anhydrous. The atomic volume of zoisite and of jadeite, as shown in the table, appears to be less than that of garnet and epidote, showing a more condensed molecule.

§ 83. We have next to notice three remarkable adamantoids, closely related to those just mentioned, and also to the spathoid ilvaite. In garnet, axinite, epidote and keilhautite, the sesquioxyd may be in large part ferric, and in schorlomite and ilvaite it is entirely so, the protoxyd bases in these being chiefly lime, magnesia and ferrous oxyd. We have in ægirite, arfvedsonite and acmite, three well-defined protopersilicates in which the sesquioxyd is entirely ferric and the protoxyd in large part sodic. These three species, which have hitherto been little understood, will be seen from the table to be related respectively, ægirite to garnet, acmite to epidote, and arfvedsonite to euclase, and to have a common value for V very near to that of garnet and epidote.

The presence, in each of these ferric species of large amounts of soda, equal to ten or twelve hundredths, is the more remarkable since the aluminous silicates with which we have compared them contain little or no alkali. This association recalls the highly alkaliferous character of another iron-silicate, glauconite. While these three homœomorphous species, all ferric unisilicates with soda, having very different ratios between protoxyds and sesquioxyds, are, from their condensed molecule, and their indifference to acids, assigned a place among adamantoids, the related ilvaite, with a larger volume, has been placed among the spathoids. It is possible, from the analysis of Rammelsberg, that babingtonite may be a ferric species belonging to the one or other of these tribes, but without farther analyses it would be premature to fix its place.

§ 84. We come next to spodumene, a lithia-alumina species with the atomic ratio, 1 : 4 : 10, remarkable for its great condensation and its volume of 4·88. It is instructive to compare it with the still more siliceous lithia-alumina silicate, petalite, which, with its lower density, has a volume of 6·33, and takes its place among the spathoids. The relations between these two silicates are analogous to those between zoisite or jadeite and a scapolite like marialite. While these two lithia-bearing species, with the ratio of protoxyd to alumina of 1 : 4, are among the most siliceous known, sapphirine, which has the same ratio, is the most basic, and with its atomic formula of $(mg_1al_4si)o_6$, serves to connect the silicates with the spinellids, while, by its great condensation, it takes a place by the side of spodumene.

Staurolite is essentially an aluminous double silicate, with the ratios of $1 : 4 : 2\frac{1}{2}$, the protoxyds being ferrous oxyd with a little magnesia, and, rarely, a portion of oxyd of zinc. In one variety it would seem that manganese-sesquioxyd replaces a portion of alumina, and a small portion of water appears to be an essential element. Omitting the water we get a volume of 5·01.

§ 85. We come now to the tourmalines, a family of silicates which, perhaps, might be called a subtribe, since the five distinct species, representing as many genera, differ from

each other, not only as the related silicates, albite, labradorite and anorthite, or as zoisite and jadeite, but also, at the same time, as anorthite differs from meionite, or as lime-garnet from idocrase or epidote. In other words, not only the relations of the protoxyds to the sesquioxyds, but the relations of both of these to the silica are subject to notable variations in species of tourmaline which so closely resemble each other that it is difficult, if not impossible, to distinguish them by physical characters alone. The studies of Rammelsberg, which first clearly showed the varying composition of the tourmalines, enabled him to divide them into five species, each of which is the the type of a genus, distinguished by the ratios of protoxyd to sesquioxyd. We follow him in regarding the boric oxyd, which is not constant in amount, as replacing silica, and recognize the fact that the tourmalines are oxyfluorids containing a small and variable amount of fluorine.

For the brown magnesia-tourmaline, the most highly protobasic species, with the atomic ratios of 1 : 3 : 5, a trivial name was needed, and we have ventured to suggest that of "coronite," from Crown Point, in New York, a well-known locality of this species; while to the black magnesia-iron tourmaline, with the ratios 1 : 4 : 6, we have given the name of "schorlite," from the ancient trivial designation of schorl, under which the tourmalines were formerly included with many other species. The names of "aphrizite" for the black ferrous tourmaline, 1 : 6 : 8; of "indicolite" for the blue and green tourmalines, 1 : 9 : 12, holding both ferrous and manganous oxyds; and of "rubellite" for the red and colorless tourmalines, 1 : 12 : 15, containing manganese but no iron, are familiar to mineralogists. It is worthy of notice that we pass, in this family, from compounds having the ratio of protoxyds to sesquioxyds found in the feldspars (coronite having the general atomic formula of iolite,) to the ratios of the muscovitic micas, and that with the diminution in the proportions of protoxyd bases, the relative amount of alkalies is augmented; while indicolite and rubellite become, like beryl, lithia-bearing. The atomic ratio of the sesquioxyds (in which alumina is sometimes partially replaced by ferric and apparently by manganic-oxyd) to the silica, with its included and varying amount of boric oxyd, is, moreover, not constant, but differs in the different species of tourmaline. There are thus many chemical variables to be taken into account in the study of a group of minerals which, from their similarity in external characters were, previous to the careful researches of chemists, united in one species, the supposed varieties of which were distinguished only by differences in color.

§ 86. We have given in the preceding paragraph, and also in table No. IX, the ratios deduced by Rammelsberg for the five species named and defined, to which it should be added that he found for a red tourmaline from Rozena, with a density of 2.998, the ratios 1 : 15 : 21. This, the least protobasic silicate of the order, should constitute a new species. The mean densities of these species, as deduced by him from a large number of examples, show but small variations, and, with the exception of the highly ferriferous aphrizite, which is 3.20, range from 3.10 to 3.04.[1] These figures are adopted in the table, save that for rubellite the density has been placed at 3.00. The equivalent volumes, as calculated by Rammelsberg from his own arbitrary formulas for these five species, respectively gave

[1] For the original memoir of Rammelsberg, see Pogg. Ann., 1850, lxxx. 449; and for a summary of his results, Amer. Jour. Science, xi. 257; also a farther discussion thereof by the present writer, *Ibid.*, xvi. 211. For later studies of the tourmalines by Rammelsberg, see Annal. Phys. Chem., 1870, cxxxix. 379 and 547.

him the discordant and apparently incommensurable numbers, 144.6, 167.3, 241.0, 117.0, and 148.0, which fail to show any relations between the species compared.

These, however, from their close resemblance in external characters, on the one hand, and their chemical differences on the other; from their varying relations between protoxyds, sesquioxyds and silica; from the partial replacement of silica by boric oxyd, and of alumina by ferric and manganic oxyds, are peculiarly fitted to test the correctness of the new method of study; and this, the careful determinations of Rammelsberg enable us to apply to the tourmalines with guarantees for accuracy not often to be met with. The results of such a study of these five species, as set down in the table above, may here be stated at greater length. In calculating the mean weight (P) of the oxyd-unit for each species of tourmaline, care has been taken to get the nearest approximation to the results of Rammelsberg's analyses of that species. The manganic oxyd in indicolite and rubellite is included with ferric oxyd, and the various protobases always present are grouped under the heads of ferrous oxyd, magnesia, soda and lithia. The formulas thus arrived at, with their fractional coefficients, and the value of the oxyd-unit, got by dividing the calculated equivalents by the number of units in each formula, are subjoined. But these formulas do not take into account the fact that all of these tourmalines contain from 1.5 to 2.5 of fluorine, replacing a portion of oxygen; the mean of this, as calculated for coronite, being about one sixtieth in atomic ratio. This proportion would give for coronite 1.93, and for rubellite 1.90 of fluorine, an addition of 0.17 and 0.18 to the value of P as calculated for the above formulas without fluorine. These values are placed within parentheses, while the corrected values for this mean proportion of fluorine are given in the subjoined table under P, and are those employed for calculating the atomic volume of the tourmalines.

TOURMALINES.	**m : *m* : si**	FORMULA.	P	D	V
Coronite. - -	1 : 3 : 5	$(si_{3\cdot75}b_{1\cdot25}al_{2\cdot80}fi_{0\cdot20}mg_{0\cdot80}na_{0\cdot20})o_{8\cdot00}$ - - - - (16 19)	16·36	3·05	5·36
Schorlite. - -	1 : 4 : 6	$(si_{4\cdot80}b_{1\cdot20}al_{3\cdot50}fi_{0\cdot50}mg_{0\cdot75}na_{0\cdot25})o_{11\cdot00}$ - - - - (16·50)	16·68	3·10	5·38
Aphrizite. - -	1 : 6 : 8	$(si_{6\cdot25}b_{1\cdot75}al_{5\cdot20}fi_{0\cdot80}fe_{0\cdot60}mg_{0\cdot20}na_{0\cdot20})o_{15\cdot00}$ - - (17·06)	17·24	3·20	5·38
Indicolite. - -	1 : 9 : 12	$(si_{9\cdot50}b_{2\cdot50}al_{8\cdot00}fi_{1\cdot00}li_{0\cdot50}na_{0\cdot50})o_{22\cdot00}$ - - - - - (16·24)	16·42	3·08	5·33
Rubellite. - -	1 : 12 : 15	$(si_{12\cdot00}b_{3\cdot00}al_{11\cdot70}fi_{0\cdot30}li_{0\cdot50}na_{0\cdot50})o_{28\cdot00}$ - - - - (15·88)	16·06	3·00	5·35

The values of V show for these five species a remarkable agreement, which testifies at once to the correctness of the principles upon which our system is based and to the accuracy of the determinations of Rammelsberg.

Tribe 9.—PROTOPERPHYLLOIDS.

§ 87. The tribe of the Protoperphylloids presents illustrations of all the principles which we have endeavored to set forth in the accounts of preceding tribes. It shows great variations in the relations of protoxyds to sesquioxyds, from highly protobasic species like phlogopite and the chlorites, with the ratio 2 : 1, to muscovites, in which it is 1 : 12. Ferric and chromic oxyds, in some species, replace more or less completely alumina, and the protobases vary, from species in which alkalies only are present, to others in which alkalies are wanting, their places being partially or wholly supplied by ferrous oxyd,

cupric oxyd, lime, magnesia and even baryta. The ratio of silica to the bases varies widely in species having the same proportions of protoxyd and sesquioxyd bases; and, moreover, species having otherwise the same chemical composition, and similar external characters, differ in the presence or the absence of water. Finally, the degree of condensation, as shown by the value of V, varies considerably among phylloids, all of which are nevertheless so well marked in their physical characteristics that the micaceous or phylloid type is one of the first recognized by the student.

X *Tribe* 9. PROTOPERPHYLLOID.

SPECIES.	FORMULA.	P	D	V	CRYS.	REMARKS.
Astrophyllite.	$(m_5m_2si_{10})o_{17}$ - (m = al, fi, zr)	....	3·24	....	Orthorh.	Titanosilicate.
Phlogopite.	$(m_4al_2si_6)o_{12}$ - ($m_4 = mg_{3\cdot5}k_{0\cdot5}$)	18·12	2·85	6·35	Orthorh.	Oxyfluorid.
Pyrosclerite.	$(mg_4al_2si_6)o_{12} + 3aq$	15·40	2·74	5·62	Orthorh.	
Penninite.	$(mg_{4\cdot0}al_{2\cdot0}si_{4\cdot5})o_{10\cdot5} + 3aq$	15·30	2·67	5·73	Rhombo.	
Ripidolite.	$(mg_5al_3si_6)o_{14} + 4aq$	15.38	2·70	5·70	Clinorh.	
Prochlorite.	$(m_4al_3si_{4\cdot66})o_{11\cdot66} + 3aq$ - ($m_4 = mg_2fe_2$)	17·72	2·96	5·98	Hexag.?	
Leuchtenbergite.	$(mg_{4\cdot5}al_{3\cdot0}si_{5\cdot0})o_{12\cdot5} + 3\frac{1}{2}aq$	15·33	2·65	5·86	Hexag.	
Venerite.	$(m_4m_2si_6)o_{13} + 4aq$	....	....	....	——?	See § 90.
Corundophilite.	$(m_4al_4si_4)o_{12} + 3\frac{2}{3}aq$ - ($m_4 = mg_3fe_1$)	16·40	2·90	5·65	Clinorh.	
Biotite.	$(m_4m_4si_8)o_{16}$ - ($m_4 = mg_{3\cdot5}k_{0\cdot5}$)	18·18	3·00	6·06	Hexag.	($m_4 = al_3fi_1$)
Voigtite.	$(m_4m_4si_8)o_{16} + 4aq$ - ($m_4 = mg_3fe_1$)	18·08	2·91	6·21	——?	($m_4 = al_3fi_1$)
Cryophyllite.	$(m_3al_4si_{14})o_{21}$ - ($m_3 = k_{1\cdot00}li_{1\cdot25}k_{0\cdot75}$)	17·65	2·91	6·06	Orthorh.	Oxyfluorid.
Seybertite.	$(m_6al_9si_5)o_{20} + \frac{1}{2}aq$ - ($m_6 = mg_4ca_2$)	18·00	3·15	5·71	Orthorh.	
Thuringite.	$(fe_6m_9si_9)o_{24} + 6aq$ - ($m_6 = al_6fi_3$)	19 56	3·19	6·13	——?	
Jefferisite.	$(mg_6m_9si_{15})o_{30} + 7\frac{1}{2}aq$ - ($m = al_6fi_3$)	15·85	....	....	Orthorh.	
Annite.	$(m_6m_{12}si_{18})o_{36}$	....	3.17	....	——?	
Willcoxite.	$(m_6al_{12}si_{10})o_{28} + 2aq$ - ($m_6 = mg_5na_1$)	16·76	....	....	——?	
Chloritoid.	$(fe_1al_3si_2)o_6 + 1aq$	18·00	3·55	5·07	Clinorh.?	
Lepidomelane.	$(m_1m_3si_4)o_3$	....	3·00	....	Hexag?	
Zinnwaldite.	$(m_1al_3si_6)o_{10}$ - ($m = k_{0\cdot5}li_{0\cdot5}$)	17·22	3·00	5·74	Orthorh.	
Oellacherite.	$(m_1al_3si_6)o_{10}$ - ($m = k_{0\cdot25}ba_{0\cdot25}mg_{0\cdot50}$)	17·33	2·99	5·79	——?	
Lepidolite.	$(m_{1\cdot0}al_{4\cdot5}si_{8\cdot0})o_{13\cdot5}$ - ($m = k_{0\cdot5}li_{0\cdot5}$)	16·88	3·00	5·62	Orthorh.	
Margarite.	$(ca_1al_6si_4)o_{11} + 1aq$	16·58	2·99	5·55	Orthorh.	
Euphyllite.	$(m_1al_8si_9)o_{18}$ - ($m = k_{0\cdot33}na_{0\cdot66}$)	18·30	3·00	6·10	——?	
Cookeite.	$(m_1al_{10}si_9)o_{20} + 5\frac{1}{2}aq$ - ($m = li_{0\cdot75}k_{0\cdot25}$)	14.60	2·70	5·40	——?	
Muscovite.	$(k_1al_6si_9)o_{16}$	17·75	3·12	5·68	Orthorh.	
Muscovite.	$(k_1al_6si_9)o_{16} + 2aq$	16 77	2·85	5·88	Orthorh.	
Muscovite.	$(k_1al_9si_{12}o_{22}$	17·27	....	....	Orthorh.	
Damourite.	$(k_1al_9si_{12}o_{22} + 2aq$	16·58	2.79	5·87	Orthorh.	
Muscovite.	$(k_{0\cdot5}al_{6\cdot0}si_{9\cdot0})o_{15\cdot5}$	16·77	....	....	Orthorh.	
Muscovite.	$(k_{0\cdot5}al_{6\cdot0}si_{9\cdot0})o_{15\cdot5} + 2aq$	15·91	2·75	5·78	Orthorh.	

§ 88. We have spoken of micas and chlorites, but the distinction is an arbitrary one, and the transition from hydrous magnesian micas like some phlogopites, to chlorites, is not so great as that from these same micas to those of the muscovitic type, often themselves hydrated. The difficulties of adequately discussing this great tribe are increased by the fact that different formulas are assigned to minerals having the same specific name. Phlog-

opite, biotite and muscovite, each include chemically unlike compounds, which should form distinct species. The muscovites present among themselves compounds differing like the tourmalines in their atomic ratios, and the micas included under the name of phlogopite show variations in the ratio of protoxyds to sesquioxyds from 2 : 1 to 3 : 2; while there are biotites from 1 : 1 to 1 : 1½ and 1 : 2. More highly protobasic than any phlogopite is, however, astrophyllite, a titaniferous mica in which the sesquioxyd is represented in part by alumina and in part by ferric and zirconic oxyds, and which gives very closely the ratios, 5 : 2 : 10. With biotites having the atomic formula, 1 : 1 : 2, we may note the more basic corundophilite, 1 : 1 : 1, near to which, in the ratio of protoxyds and sesquioxyds, come the highly siliceous fluoric lithia-mica, cryophyllite, 3 : 4 : 14, and the basic seybertite and willcoxite. The ratio of protoxyds and sesquioxyds in the latter 1 : 2, is that of some biotites, and of the ferric species, annite, near to which is the still more ferriferous lepidomelane, apparently 1 : 3 : 4. A like ratio appears in the dense basic chloritoid, 1 : 3 : 2, and in the more silicic zinnwaldite, 1 : 3 : 6, followed by the barytic species, oellacherite, 1 : 4 : 6.

After lepidolite, probably 1 : 4½ : 8, and like zinnwaldite, a highly fluoriferous mica, remarkable for containing lithia with caesium and rubidium, we come to the muscovites proper, with which the last two species are connected by the fact that their protoxyd bases are alkalies only. The variations noted in the ratio of these to the sesquioxyds, (in which ferric oxyd replaces a small portion of alumina) are from 1 : 6 to 1 : 9 and 1 : 12, and the ratio of the sum of these to the silica in different analyses is from 1 : 1¼ to 1 : 1½. From various muscovites have been deduced the atomic ratios, 1 : 6 : 9, 1 : 9 : 12 and 1 : 12 : 18, with others intermediate, and a careful study would probably show, as in the case of the tourmalines, the existence of a series of muscovites. Near the muscovite, with the ratio first named, must be placed the less siliceous and somewhat calcareous species, margarite, 1 : 6 : 4, and farther on, euphyllite, 1 : 8 : 9, and cookeite, 1 : 10 : 9.

§ 89. It will be noted that in this list we have included both hydrous and anhydrous species, between which it is impossible to draw a line of demarcation. Phlogopites and biotites are reputed anhydrous, but, as is well known, contain in many cases from two to four hundredths of water, while corundophilite, willcoxite, seybertite, chloritoid, oellacherite, margarite, euphyllite and cookeite, are all more or less hydrous; the amount of water rising to six hundredths in euphyllite, and to twice that amount in cookeite. Among muscovites, in like manner, water is found in all proportions, up to hydrous species like damourite and paragonite, which last may be described as a hydrous soda-muscovite. The presence or absence of water in phylloids cannot form the ground of a distinction in classification among phylloids any more than in adamantoids, where we find bertrandite, beryl, euclase, ardennite, epidote and malacone, in all of which water enters as an essential element.

§ 90. The various minerals which constitute the chloritic group are hydrous magnesian micas, nearly related to the phlogopites and the biotites. While pyrosclerite is simply a hydrous phlogopite, with the atomic ratios, apart from the water, of 4 : 2 : 6, penninite is a less siliceous species, represented by 4 : 2 : 4½. After these come the closely related ripidolite, leuchtenbergite, venerite and prochlorite. Venerite is remarkable as an example of a well defined and crystalline chloritic species very near to prochlorite in composition,

but containing a large proportion of copper.[1] Corundophilite follows, with 4 : 4 : 4, and the more siliceous voigtite, 4 : 4 : 8, a hydrous biotite. From this we pass to jefferisite, 4 : 6 : 10, a highly hydrated species having the same ratio of protoxyds and sesquioxyds as thuringite, and as the more basic and nearly anhydrous seybertite, 4 : 6 : 3⅓. Following these, among hydrous species, are willcoxite, chloritoid, oellacherite, margarite, cookeite and damourite. We have, in fact, throughout the whole protoperphylloid tribe, from phlogopite to muscovite, an anhydrous and a hydrous series, and the chloritic group is made up of the more highly protobasic members of the latter. In these comparisons we have generally deduced the atomic ratios from the formulas given in Dana's "System of Mineralogy," which represent approximately the results of chemical analysis. The late

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[1] This species, which was described by the writer in 1876, is found in the Jones (or Johannes) Mine, in Carnarvon, Bucks County, Pennsylvania, long known as a large deposit of maguetite associated with chalcopyrite, malachite, chrysocolla and a substance which had hitherto been called clay-carbonate copper ore, of which several thousand tons, yielding from six to seven per cent. of copper, had up to that time been mined and utilized in smelting. These ores are found in the Taconian crystalline schists of the region, the so-called Primal slates of Rogers, and the mineral in question is distributed in greater or less abundance, through several feet of the strata, alternating with layers of a coarse granular material poor in copper, the whole marked with ferruginous bands which coincide with the bedding, and intersected with veins of quartz: layers of half an inch or more in thickness were found to contain ten or twelve per cent. of copper.

"These pure portions have a pea-green or apple-green color when moist, becoming greenish-white on drying, when the mass falls into a powder, which is seen under the microscope to consist of minute, transparent, shining scales, mixed however with some grains of quartz and a small portion of magnetite. A qualitative examination of this material showed that it contains no carbonates, and is not of the nature of a clay, but consists of a hydrous silicate of magnesia, copper-oxyd, alumina, and iron-oxyd, constituting a kind of copper-chlorite. It is but feebly attacked by dilute acids, while strong acids, and notably sulphuric acid diluted with two or three parts of water and aided by a gentle heat, readily and completely decomposes it, with separation of flocculent silica, which, by solution in dilute soda-lye, is readily separated from accompanying quartz and magnetite. A single somewhat rough analysis made in this way, gave me, for 100 parts,—insoluble sand, 14.10; silica, 24.60; alumina, 13.00; magnesia, 15.15; ferric oxyd, 7.11; cupric oxyd, 15.30; water, 11.50 = 100.70. The qualitative examination of a considerable portion of another and less pure specimen, gave an appreciable quantity of zinc, and a distinct trace of nickel. A portion of the specimen of this copper-silicate of which the analysis is given above, was freed by careful washing alike from the coarser grains and from the lighter portion, which remained long suspended in water. The material thus purified was somewhat richer in copper than before, and has been carefully analyzed by my friend, Mr. George W. Hawes, of New Haven, who found insoluble sand, 6.22; silica, 28.93; alumina, 13.81; ferric oxyd, 5.04; ferrous oxyd, 0.27; magnesia, 17.47; cupric oxyd, 16.55; water, 12.08 = 100.37. This, deducting the insoluble matter, gives for 100 parts: silica, 30.73; alumina, 14.67; ferric oxyd, 5.35; ferrous oxyd, 0.29; magnesia, 18.55; cupric oxyd, 17.58; water, 12.83 = 100.00. This, as remarked by Mr. Hawes, gives, on calculation, an oxygen ratio between protoxyds, sesquioxyds, silica, and water, of 4 : 3 : 6 : 4, very nearly, which puts this mineral, if it be a homogeneous substance (as its microscopic characters would indicate), among the chlorites, some of which it resembles very closely in its atomic ratios. Before the blowpipe on charcoal it swells, then fuses quietly into a black globule, giving the usual reactions for copper. The iron is almost wholly in the state of sesquioxyd, as shown by two determinations of the amount of protoxyd of iron, which gave, respectively, 0.27 and 0.29 per cent. This copper-chlorite appears alike from its physical and chemical characters to constitute a distinct mineral species, for which I propose the name of VENERITE, in allusion to the mythological and alchemistic name of copper."—("A New Ore of Copper and its Metallurgy." Trans. Amer. Inst. Mining Engineers, iv. 325.)

The atomic formula for venerite given in the table above represents it as a chlorite in which a part of the sesquioxyd is ferric and a part of the protoxyd is cupric. This formula $(mg_{2\cdot75}cu_{1\cdot25}al_{2\cdot50}fi_{0\cdot50}si_{6\cdot00})o_{13\cdot00}+4aq.$, requires silica, 31.4; alumina, 14.8; ferric oxyd, 4.6; magnesia, 19.2; cupric oxyd, 17.4; water, 12.6 = 100.0, which agrees very closely with the numbers deduced by Hawes from his analysis, and varies but little from my own analysis, given above, of a less pure specimen, when calculated for 100.0 parts. A microscopic examination of this curious chlorite will suffice to show its distinctness, and the judgment of Hawes thereon is confirmed by that of Des Cloizeaux, according to his private communication to the writer.

elaborate chemical studies of Rammelsberg, when properly interpreted, will throw much light on the constitution of the micas.[1] For greater simplicity the water-ratios, which are given in Table IX, are here omitted.

§ 91. Related to the chlorites, but differing in structure, is the epichlorite of Rammelsberg, described as fibrous or columnar, and having the atomic ratios, 4 : 3 : 9 : 4, which corresponds to a more siliceous prochlorite. In this connection may be mentioned a hitherto undescribed mineral which is found in veins in the anthracite and its accompanying carbonaceous shales at Portsmouth, Rhode Island. This substance is sometimes found penetrating quartz, but in its pure state appears as a greyish green mass, consisting of fine flexible fibres resembling chrysotile or amianthus, with which it has been confounded. A portion from a vein about an eighth of an inch wide gave me by analysis: silica, 27.80; alumina, 21.80; ferrous oxyd, 26.10; magnesia, 8.96; lime, 2.01; potash, 2.69; soda, 4.24; volatile, 9.30 = 102.90. A subsequent microscopic examination of the material analyzed showed the presence therein of interspersed films of pyrites, thereby vitiating to some extent the results of the analysis, which deserves to be repeated on a portion of the mineral purified by the aid of bromine-water. Making allowance for some pyrites, the atomic ratios of this fibrous species are 4 : 4 : 6 : 3, being near to prochlorite and to voigtite which like it contains a little lime and soda. In this unnamed amianthoid mineral from Portsmouth, possessing nearly the composition of a chlorite or a hydrous biotite, and in the epichlorite of Rammelsberg, we have apparently examples of a hydrospathoid form of these alumino-magnesian protopersilicates.

With these should be noted the pilolite of Heddle, who has described under that name the substances hitherto known as mountain cork and mountain leather, which have a fibrous texture, are more or less flexible and tough, and occur in veins or fissures alike in crystalline limestone, in sandstones and shales, and also, as observed by the writer, as a deposit upon quartz crystals in granitic veins. From several analyses by Heddle, pilolite is shown to be a highly hydrated silicate of alumina and magnesia with ferrous oxyd, and is nearly represented by $(mg_{2\cdot5}fe_{0\cdot5}al_2si_{15})o_{20}+12aq$, a formula requiring silica, 51·7; alumina, 7·8; magnesia, 11·5; ferrous oxyd, 6·2; water, 24·8 = 100·0. More than one third of the combined water is expelled at a temperature of 100° centigrade.[2]

Tribe 10.—Pinitoids.

§ 92. Corresponding with the ophitoids of the protosilicates, we find in the present suborder a tribe of hydrous silicates which, since the species known as pinite may be taken as the type, we have called Pinitoids. These bodies approach in composition and in density the hydrous muscovitic micas, with compact varieties of which they may be confounded. The true pinitoids, however, appear to be amorphous colloidal silicates like serpentine; while pinite itself with its varieties, which have been described under the various names of gieseckite, agalmatolite, dysyntribite and parophite, though generally amorphous, seems in some cases, like the serpentinic silicate, to be crystalline. We have

[1] I have to acknowledge my indebtedness in very many cases to the First Appendix to Dana's Mineralogy by Brush in 1872, and to the Second and Third Appendiices by E. S. Dana in 1875 and 1882.

[2] Mineralogy Mag., 1879, ii. 206, cited in the Third Appendix to Dana's Mineralogy, p. 94.

elsewhere noted the occurrence of this material in rock-masses,[1] but it also appears as a result of the alteration of crystals of other species. Pinite is essentially a silicate of potash and alumina, having the atomic ratios of 1 : 8 : 12 : 3, and thus approaching closely in composition to a hydrous muscovite. Cossaite, which has the ratios of 1 : 9 : 12: 2, is, if not a pinitoid, a compact paragonite or hydrous soda-muscovite, and gümbellite, which resembles it, with the ratios, 1 : 12 : 21 : 5, is probably rather a compact phylloid than a pinitoid. A careful study of the optical characters of these species will serve to fix their place in the system of classification. Jollyte, the most protobasic of the species which we have included in this tribe, has the atomic ratios, 1 : 2 : 3 : 2, the protoxyd bases being ferrous oxyd and magnesia. The minerals known as fahlunite, esmarkite, aspasiolite and hydrous iolite, are amorphous silicates with varying amounts of water and the atomic ratios, 1 : 3 : 5,—the protoxyd bases, as in jollyte, being chiefly ferrous oxyd and magnesia, with a little potash. Bravaisite, with the ratios, 1 : 3 : 9 : 4, and hygrophilite, 1 : 5 : 9 : 3, are similar species, the protoxyd base of which, as in pinite, is chiefly potash.

XI. *Tribe* 10. PINITOID.

SPECIES.	FORMULA.	P	D	V
Jollyte. - - - -	$(m_1al_2si_3)o_6 + 2aq$ - $(m = fe_{0\cdot6}mg_{0\cdot4})$ - -	15·62	2·61	5·98
Fahlunite. - - -	$(m_1al_3si_5)o_9 + 1aq$ - $(m = fe_{\frac{1}{3}}mg_{\frac{2}{3}})$ - - -	16·03	2·70	5.92
Esmarkite. - -	$(m_1al_3si_5)o_9 + 2aq$ - - - - - - - -	....	....	....
Bravaisite. - -	$(k_1al_3si_9)o_{13} + 4aq$ - - - - - - - - -	....	....	....
Hygrophilite. -	$(k_1al_5si_9)o_{15} + 3aq$ - - - - - - - - -	....	....	....
Pinite. - - - -	$(k_1al_8si_{12})o_{21} + 3aq$ - - - - - - - - -	16·25	2·80	5·80
Cossaite. - - -	$(na_1al_9si_{12})o_{22} + 2aq$ - - - - - - - -	15·91	2·89	5·50

With these pinitoids we have placed obsidian, pitchstone, tachylite and palagonite, to which latter the atomic ratios, 1 : 2 : 4, excluding water, have been assigned. That its composition is not clearly fixed, or rather that more than one silicate may have been included under this title, does not detract from the interest which attaches to this curious, unstable hydrous colloid, so long since the object of studies by Bunsen, the importance of which I have elsewhere pointed out, and which are noted below in § 109.

§ 93. The species of the suborder of protopersilicates which approach the persilicates in composition, resist chemical agencies more than those species which contain larger amounts of protoxyd bases. To this greater stability is due the fact that such species are often produced by the partial transformation, through aqueous influences, of silicates like the protoperspathoids. Such silicates, formed originally by igneous or by aqueous action, may thus continue to lose protoxyd bases, often with silica, until a condition of comparative fixity is reached by the production of bodies having the chemical composition of pinite, of the muscovitic micas, and even of pyrophyllite or of kaolin. Inasmuch as such compounds are in many cases the result of a secondary process like that just described, chemists have been disposed to assign a similar origin to them wherever found, not considering that where the proper chemical conditions unite, these com-

[1] The Origin of Crystalline Rocks; Trans. Roy. Soc. Canada, Vol. ii. Sec. 3. p. 52.

pounds may be directly formed. That nephelite, for example, may, as is supposed, under favoring circumstances, be transformed into pinite, is due to the chemical stability under these circumstances of this latter compound, and the frequent occurrences of pinite and the similar silicates, under such conditions, are illustrations of the survival of the fittest in the inorganic world. But these very relations which conduce to the production of such stable compounds by epigenesis, that is to say as a result of transformation through aqueous action, are evidently such as would lead, under favouring conditions, to the direct generation of the same or chemically similar compounds. Thus, for example, while the pseudocrystalline form of pinite in the case just mentioned shows its epigenic origin, the occurrence in granitic veinstones, in intimate association with orthoclase, tourmaline and quartz, of muscovite, a silicate very similar in centesimal composition to pinite, is unquestionably an example of direct production from solution. As regards the large beds of stratiform rocks evidently of aqueous origin, made up chiefly or entirely of a silicate having the composition and the physical characters of pinite, such as occur at various geological horizons, and, as I have elsewhere described,[1] it seems not less difficult to assign to them an epigenic origin. In other words, the beds of pinite, or beds of mica-schist, like the muscovitic micas of granitic veins, have not been produced by the transformation *in situ* of more highly alkaliferous silicates, but are either the results of the subsequent molecular rearrangement or diagenesis of sediments derived from partially decomposed silicates, perhaps not without admixtures of aqueous deposits of chemical origin, or else, as in the case of such minerals in veinstones, are entirely from the latter source.

§ 94. Crystalline forms, as displayed in what are called pseudomorphs, may and often do give evidence of transformations through aqueous agency, in silicates, as in other orders of minerals. Such changes have been especially effected in fissures and open cavities, which have been channels for waters of changing composition and temperature, during the long process which has filled these openings with mineral masses. In this way, crystals deposited at one stage are attacked at another, and are either more or less completely dissolved or transformed into insoluble products which are now found surrounding nuclei of the unchanged mineral, or in some cases penetrating its substance. Examples of such actions are familiar to all who have studied attentively the history of granitic and related veinstones. Care should, however, always be taken in the study of pseudomorphs to keep in mind another and a different phenomenon, namely, that resulting from the power of a substance in the process of crystallization to cause other bodies to assume its own geometric form. Examples of these are seen in the cases of calcite, dolomite and gypsum crystallizing in the midst of siliceous sand, by which are generated such aggregates as the so-called crystallized sandstone of Fontainebleau, which, while having a crystalline shape belonging to calcite, includes from 50 to 63 per cent. of quartz grains. A not less remarkable case is seen in staurolite, which, according to Lechartier, retains its crystalline form and general aspect, even when by the inclusion of foreign matters, chiefly quartz, the proportion of silica is raised from the normal content of 28.0 to 50.0, and even 54.0 per cent., corresponding to more than one part of quartz with two parts of staurolite, the mixture still retaining the crystalline form of the latter species. Thus a compound in crystallizing may

[1] Trans. Roy. Soc. Canada, Vol. ii. Sec. 3. p. 52, and Geology of Canada, 1863, p. 482–486.

give its geometric form to a large portion of some extraneous matter, which it compels, as it were, to assume its own crystalline shape.

Tribe 13.—Peradamantoid.

§ 95. It may be noticed that in the second suborder the less protobasic silicates do not assume zeolitoid or spathoid forms. With the exception of sloanite and forestite (both of which demand further study) we find no species in these tribes having a ratio of protoxyds to sesquioxyds greater than 1 : 4; those presenting the higher ratios, up to 1 : 12, being adamantoids, phylloids and pinitoids, through which this suborder is connected with that of the persilicates. As might be expected, we find these conditions continued in the latter suborder, in which all the species known are, with one exception, included in the corresponding tribes. These are designated, as we have seen, peradamantoid, perphylloid and argilloid, which latter represents the pinitoid and ophitoid tribes of the preceding suborders. The single exception as yet known is the westanite, described by Blomstrand,

XII. *Tribe* 13. Peradamantoid.

Species.	Formula.	P	D	V	Crys.
Dumortierite. -	$(al_2si_1)o_3$ - - - - - - - - -	16·33	3·36	4·86	Orthorh.
Andalusite. - -	$(al_3si_2)o_5$ - - - - - - - - -	16·20	3·35	4·83	Orthorh.
Fibrolite. - - -	$(al_3si_2)o_5$ - - - - - - - - -	16·20	3·35	4·83	Clinorh.
Topaz. - - - -	$(al_3si_2)o_4fl_1$ - - - - - - - -	18·40	3·65	5·04	Orthorh.
Cyanite. - - -	$(al_3si_2)o_5$ - - - - - - - - -	16·20	3·66	4·42	Anisom.
Bucholzite. - -	$(al_3si_3)o_6$ - - - - - - - - -	16·00	3·24	4·90	Clinorh.
Xenolite. - - -	$(al_3si_3)o_6$ - - - - - - - - -	16·00	3·58	4·46	Clinorh.
Wörthite. - - -	$(al_6si_5)o_{11} + 1aq$ - $(aq = 4·56)$ -	15·50	....	....	Clinorh.
Lyncurite. - -	$(zr_1si_1)o_2$ - - - - - - - - -	22·75	4·05	5·61	Tetrag.
Malacone. - - -	$(zr_1si_1)o_2 + \frac{1}{3}aq$ - $(aq = 4·70)$ -	21·22	4·00	5·30	Tetrag.
Zircon. - - - -	$(zr_1si_1)o_2$ - - - - - - - - -	22·75	4·70	4·84	Tetrag.
Auerbachite. - -	$(zr_2si_3)o_5$ - - - - - - - - -	21·20	4·06	5·22	Tetrag.
Anthosiderite. -	$(fi_1si_3)o_4 + \frac{1}{3}aq$ - - - - - - -	17·15	3·00	5·71	—— ?

which, from the details given, would seem to be a hydroperspathoid, having the atomic ratios for alumina and silica of the peradamantoid wörthite. We may perhaps hope for the discovery of further examples of this tribe and also of perspathoids.

§ 96. The adamantoid persilicates constitute a characteristic and remarkable group. Of the aluminic species, we find dumortierite, andalusite, fibrolite, bucholzite and wörthite, with differing atomic ratios, and in one case hydrous, all presenting the same value for V; besides the remarkable oxyfluorid, topaz, and the more highly condensed kyanite and xenolite, the latter two having a smaller atomic volume than any other silicates known. A single ferric species, anthosiderite, appears, and more than one zirconic species.

It is known that minerals, having the crystalline form and the centesimal composition of zircon, present variations in density from 4.86 to 4.02. The careful studies of A. H.

Church, in 1875, confirmed the previous statements as to the differences in density among the minerals included under the name of zircon. Thus he found the hyacinth-red crystals of Expailly to have a specific gravity, 4.863, which was not changed by ignition. A large number of zircons examined by him, not less than twelve in number, varied from 4.60 to 4.70, while an opaque brown zircon from North Carolina had a density of 4.54, which was changed to 4.67 by long ignition, and a transparent brown zircon from Frederickvärn had its density by the same process raised from 4.48 to 4.63. Another zircon, dark green in color, slightly opalescent and flawless, had a specific gravity of only 4.02, which was not changed by ignition. It was, nevertheless, according to Church, a true zircon, giving by analysis the percentages of that species.[1] Auerbachite, an isomorphous zirconic species, has, with different atomic ratios, a specific gravity of 4.05, and agrees in volume with malacone, a hydrous zircon, which has a similar density, while other related hydrous zirconic silicates give specific gravities of from 4.00 to 3.60. It would appear that the zirconic, like the aluminic adamantoids, exhibit species varying alike in atomic ratio, in condensation, and in the presence and absence of water. An anhydrous zircon, with the ratio of 1 : 1, and a density of 4.86, has an atomic volume of 4.68; and one of 4.70, a volume of 4.84; while a zircon, with the lower density of 4.02, has a volume of 5.65. This last we may distinguish by the trivial name of "lyncurite," from the *lyncurion* of Theophrastus,[2] while the denser zircon of Expailly may also, perhaps, require a distinctive name.

Tribe 14.—Perphylloid.

§ 97. As regards the phylloid tribe of the persilicates, an important chapter of their history is connected with pholerite and kaolinite. It was in 1825, that Guillemin described under the name of pholerite a hydrous silicate of alumina, micaceous in structure, to which he assigned the atomic ratio for alumina, silica and water of 3 : 3 : 2. This was the same as that deduced from the analyses of Brongniart and Malaguti for

XIII. *Tribe* 14. Perphylloid.

Species.	Formula.	P	D.	V	Crys.
Pholerite. - - -	$(al_3si_3)o_6+2aq$ - - - - - -	14·50	2·51	5·77	Orthorh.
Talcosite. - - -	$(al_5si_6)o_{11}+1aq$ - - - - - -	15.33	2·50	6·13	—— ?
Kaolinite. - - -	$(al_3si_4)o_7+2aq$ - - - - - -	14·33	2·63	5·44	Orthorh.
Pyrophyllite. - -	$(al_2si_3)o_5+\frac{1}{3}aq$ - - - - - -	15·00	2·80	5·35	Orthorh.
Pyrophyllite. - -	$(al_{1·6}si_{2·3})o_{3·5}+\frac{1}{3}aq$ - - - - -	15·00	2·92	5·13	Orthorh.

ordinary kaolin, although Forchammer had proposed for the latter the ratios, 3 : 4 : 2. The uncertainty as to the composition of these silicates which prevailed thirty years since, is reflected in the fourth edition of Dana's "System of Mineralogy," published in 1854, where the first-named ratio was ascribed to kaolin, with the remark that it occasionally presents the second ratio; while of pholerite it was said "that it does not differ much from

[1] Church on Densities of Precious Stones; Geological Magazine for 1875.

[2] Moore's Ancient Mineralogy, p. 145.

kaolin in composition." Hence it was that when, in the same year the writer found and analyzed a crystalline micaceous kaolin, giving for its composition, silica 45.50-46.05, alumina 38.37, lime 0.61, magnesia 0.63, water, 13.90 = 99.56, the analyses of pholerite and of kaolin were discussed by him, and the conclusion was reached that the first ratio mentioned might represent the composition of both of these substances when free from foreign matters, and consequently that "the mineral in its pure form is no other than a crystalline kaolin." In 1863, in accordance with this view, kaolin and pholerite were regarded as identical. Of pholerite, it was then said that "it may be regarded as that substance [kaolin] in a crystalline condition. From its foliated or micaceous structure it may be considered as a hydrated mica."[1] It should here be added that the writer had in 1855 an opportunity of comparing the crystalline mineral from Canada with the original pholerite, and of discussing the question of the minerals with Guillemin in Paris.

§ 98. It was not until 1867 that this subject was again taken up, and this time by S. W. Johnson and J. M. Blake,[2] who showed that as regards the composition of kaolin, the ratio of 3 : 3 : 2 was inadmissible, and that the ratio, 3 : 4 : 2, deduced by Forchammer, was the true one. They farther called attention to numerous observations showing the occurrence of kaolin in a foliated crystalline form, which, according to them, is never wanting in the mineral, and proposed for crystalline kaolin the name of "kaolinite," without, however, alluding to my own published observations on the subject. This historical sketch will serve to show why the present writer, while recognizing in 1854 and 1863 the crystalline character of kaolin, was led, from the uncertainty then prevailing as to the true composition of these substances, to describe crystallized kaolin under the name of "pholerite," as a hydrous mica. While the title of kaolin to the rank of a hydrous phylloid or persilicate mica, with the ratios, 3 : 4 : 2, is clear, the name of pholerite must be reserved for a similar species with the ratios, 3 : 3 : 2. Intermediate between pholerite and kaolinite in composition is the talcosite of Ulrich, to which he has ascribed the atomic ratios for alumina, silica and water, of 5 : 6 : 1. To these succeed the pyrophyllites, the two formulas assigned to which give the same value for P, while the recorded densities indicate for the mineral a high degree of condensation.

Tribe 15.—ARGILLOID.

§ 99. In the last place remains to be noticed the percolloid tribe, to which, from the fact that it includes various hydrous aluminous silicates known as clays, we have designated Argilloid. While a mineral having the composition assigned to kaolin appears as a phylloid, and while Johnson and Blake, from their microscopic examinations, concluded that such a phylloid species appears in all kaolins, it is not improbable that there may, at the same time, exist a true argilloid or colloidal silicate having the composition assigned to kaolin, and, consequently, less hydrated than halloysite. For this reason kaolin is retained in the accompanying table of argilloids. We have noticed in the other suborders the close relations between the ophitoids and pinitoids and their corresponding phylloids.

[1] See Hunt, Report of Geological Survey of Canada, 1853-56, p. 386, and further, Geology of Canada, 1863 p. 495.

[2] Amer. Jour. Science, xliii. 351.

Beginning with the most basic of the clays, we have given in Table XIV their atomic formulas, with the values of P and V, so far as these can be determined.

§ 100. The genesis of these persilicates, whether phylloid or colloid, here demands consideration. The subaërial decay of the aluminous spathoids, orthoclase and albite, is apparently the direct source of ordinary kaolin, for which the ratios of protoxyd, alumina, silica and water are 0 : 3 : 4 : 2. The derivation of this from feldspars, having for the same elements the ratios, 1 : 3 : 12 : 0, is due to the loss of all protoxyds and two thirds of the silica, and the hydration of the residue. The adamantoid and phylloid aluminous protopersilicates are not generally subject to such transformations, although Damour has described a silicate with the composition of kaolin, derived from the decay of beryl. It is important in this connection to study farther the subaërial decay of other aluminous spathoids, regarding the results of whose transformations very little is known. The

XIV. *Tribe* 15. ARGILLOID.

SPECIES.	FORMULA.	P	D	V
Schrötterite. - -	$(al_4si_1)o_5+5aq$ - - - - - - - - - - -	12·80	2·15	5·95
Collyrite. - - -	$(al_3si_1)o_4+4\frac{1}{2}aq$ - - - - - - - - - -	12·53	2·15	5·83
Allophane. - -	$(al_5si_2)o_5+6aq$ - - - - - - - - - - -	12·27	1·89	6·52
Samoite. - - -	$(al_1si_1)o_2+5aq$ - - - - - - - - - - -	....	....	....
Halloysite. - -	$(al_3si_4)o_7+3aq$ - - - - - - - - - - -	13·80	2·40	5·75
Kaolin. - - - -	$(al_3si_4)o_7+2aq$ - - - - - - - - - - -	....	....	....
Keramite. - - -	$(al_2si_3)o_5+2aq$ - - - - - - - - - - -	....	....	....
Wolchonskoite. -	$(cr_2si_3)o_5+3aq$ - - - - - - - - - - -	....	....	....
Montmorillonite.	$(al_1si_2)o_3+2aq$ - - - - - - - - - - -	13·00	2·04	6.37
Chloropal. - - -	$(fi_1si_2)o_3+1\frac{1}{2}aq$ - - - - - - - - - -	13·57	2·87	5·42
Cimolite. - - -	$(al_1si_3)o_4+1aq$ - - - - - - - - - - -	14·20	2·30	6·17
Smectite. - - -	$(al_1si_4)o_5+4aq$ - - - - - - - - - - -	12·55	....	....

kaolin of Passau, in Bavaria, coming from the decay of a scapolite, of which it sometimes retains the external forms, differs alike in its composition and the process of its generation from the kaolin of orthoclase or albite. The scapolite of Passau is ekebergite, with the atomic ratios, 4 : 9 : 18, or, if we compare its formula with that of albite, has for protoxyds, alumina, silica and water, $1\frac{1}{3}$: 3 : 6 : 0. The resulting aluminous silicate gives, according to the analysis of Von Fuchs, not 0 : 3 : 4 : 2, but 0 : 2 : 3 : 2 (= silica 46.4, alumina 35.0, water 18.6). This distinct and hitherto unnamed clay may be called "keramite," and is remarkable as resulting from the decay of a spathoid near in composition to labradorite, the ratios for which are 1 : 3 : 6 : 0. A similar kaolinization of labradorite would involve the removal with the protoxyds of only one fourth of the silica. The possible results of such a transformation of this and related feldspars, great quantities of which exist in the earlier crystalline rocks, are important alike in relation to the soluble matters removed and the residual aluminous silicates, both of which, in past ages, must have played a considerable part in the chemistry of sea and land.

The apparent kaolinization of leucite, is remarkable in its chemical result. It was shown by Rammelsberg that the crystals of white and kaolin-like leucite found at Rocca

Monfina, in Italy, consist of a hydrous soda-alumina silicate, having the composition of analcite. This observation the writer has confirmed, a large crystal from the same locality, soft, white and earthy in texture, having yielded him on analysis ten per cent. of soda, besides a little potash.

§ 101. In the study of these persilicates it becomes necessary in each case to determine whether we have to do with really amorphous and argilloid species, or, as in the case of crystalline kaolin and pholerite, with phylloids, which are apparently less hydrated than the argilloids. The origin of the more and of the less aluminous species, like allophane and schrötterite on the one hand, and like montmorillonite and cimolite on the other, remains be discovered. These seem, for the most part, to be like halloysite, true colloids, and their separation from aqueous solution is apparent from the occurrence noted by Daubrée of an amorphous halloysite-like matter deposited by the thermal water of Plombières in France, which is probably identical with the saponite of Nickles, a highly hydrated silicate, more siliceous than halloysite, from the same thermal spring.

These aluminous silicates, like other colloids, such as opal and beauxite, are probably capable of assuming a soluble modification, and have all been deposited from solutions. That such a dissolution and deposition takes place on a large scale is apparent from the existence of the so-called indianaite. This name has been given to a material found in the coal-measures in the State of Indiana, where it has been mined and employed to a considerable extent in the manufacture of potter's ware. It occurs in irregular beds, often several feet in thickness, beneath a stratum of sandstone, and is associated with and overlies limonite. It is often translucent in aspect, with a conchoidal fracture, and has all the aspect of a colloid. In composition it is somewhat more basic than halloysite, the atomic ratios of alumina and silica being about 6 : 7, and may perhaps be regarded as this species with an admixture of allophane, translucent masses of which, in a pure state, are found imbedded therein. Indianaite contains about 23·0 hundredths of water, which after a long exposure to a temperature of 100° centigrade, is reduced to 14·5.[1] The species, wolchonskoite and chloropal, which we have placed in the table near to keramite and montmorillonite, show that chromic and ferric silicates present similar conditions to the silicates of alumina.

§ 102. We have thus far, in the third part of this essay, briefly explained the application of our system of mineral classification to the natural silicates, and have endeavored to show how the three suborders into which these may, on chemical and genetic grounds, be separated, are each divided into five tribes by physical differences repeated more or less completely in each suborder. The spathoid type is naturally separated into two parts, the one highly hydrated, constituting the hydrospathoid tribes, represented in the first and second of these suborders by what we have called the pectolitoids and zeolitoids, both readily decomposed by acids, even in the case of the more highly siliceous species. The other part, anhydrous, or with a smaller portion of combined water, seldom over one or two hundredths, includes the protospathoid and protoperspathoid tribes, in the latter of which the more siliceous species resist the action of acids. The hydrospathoids and spathoids in the first two suborders (with a few exceptions which have been noted) agree in having a larger volume than the species of the succeeding tribes. The

[1] Reports Geological Survey of Indiana, 1874, p. 15, and 1878, p. 154.

first two tribes are unknown, or doubtfully represented, in the third suborder. The adamantoids in the three suborders are distinguished by their hardness and their molecular condensation, and, save in the case of the more basic protadamantoids, by their resistance to acids. A small proportion of water enters into the composition of many of these species, not only in bertrandite, but in euclase and beryl, and even in epidote and tourmaline, in wörthite and in malacone. It is to be noted also that the aluminic protoperadamantoids are not, so far as is known, generated by cooling from igneous fusion; but, on the contrary, by the action of heat, even below their melting points, undergo a chemical change, shown by a diminution of density and by a susceptibility to the action of acids (§ 36). The atomic volume of the adamantoids, while in certain cases not very far removed from that of spathoids, is always less, and in the harder or more gem-like species indicates a great degree of condensation. These characters are especially marked in the peradamantoids, which include the silicates of the lowest known atomic volumes.

The great phylloid or micaceous type is, like the adamantoid type, represented in each suborder, and approaches it in condensation. The phylloids in the second suborder, where they are most largely developed, include both anhydrous and hydrated species, and in the less protobasic forms exhibit much of the same chemical indifference to acids and to atmospheric action which distinguishes the aluminic adamantoids. The species of all these tribes are crystalline, and the system of crystallization to which they belong has, wherever known, been given in the preceding tables.

§ 103. The colloid forms of matter which appear in each suborder, and which we have designated respectively ophitoids, pinitoids and argilloids, are, as is well known, generated both by aqueous and igneous processes, and hence include, as might be expected, both hydrous and anhydrous species. Those formed either directly or indirectly by the igneous method are necessarily very indefinite in composition, being volcanic glasses or the results of their hydration. The tendency to chemical change exhibited by colloids was insisted on by Graham, and in view of this characteristic, as shown by Bunsen in his studies of palagonite, which is readily transformed by heat, in part, into a crystalline zeolite, the writer has elsewhere spoken of this hydrated protopercolloid as a mineral protoplasm,[1] a designation equally applicable to other colloidal silicates. Of these, serpentine gives rise to various crystalline species, often hydrated, such as chrysotile, marmolite, talc, enstatite and chrysolite, which are generated in its mass by aqueous action, while by igneous fusion it is changed into a mixture of enstatite and chrysolite.

§ 104. Obsidian and pitchstone with its varieties, and tachylite and palagonite, are examples of protopercolloid silicates more or less hydrated, with the exception of the first, and susceptible, like artificial glasses, of devitrification or conversion into crystalline silicates. This process is well illustrated by the studies of Fouqué and Michel Levy, who have shown that by maintaining in fusion for many hours vitreous mixtures of proper composition, it is possible to produce at will such crystallized species as chrysolite, pyroxene, magnetite, feldspar, leucite and melilite, which separate from the colloid mass, as from a solution, at temperatures below the fusing points of these species.[2] Similar transformations occur in the presence of water, as when common glass by the action of water at

[1] See the Origin of Crystalline Rocks, Trans. Roy. Soc. Canada, Vol. ii. Sec. 3. pp. 33, 65.

[2] Synthèse des Minéraux et des Roches, Fouqué et Michel Lévy, 1882, pp. 45, 80.

high temperatures under pressure, is changed into crystalline quartz, pyroxene and a pectolitic silicate, or when at ordinary temperatures gelatinous precipitates become crystalline in an aqueous medium. In like manner, the amorphous persilicates left by the decay of aluminous spathoids such as feldspars, pass into phylloid species like kaolinite and pyrophylite, or into adamantoid species like andalusite, fibrolite and cyanite, while the spontaneous change of certain anhydrous colloids into the crystalline state at ordinary temperatures is seen in the well known examples of vitreous arsenic trioxyd and barley-sugar. The above considerations as to the nature and relations of colloids, upon which the writer has elsewhere insisted, will help to show their importance in a scientific study of mineralogy.[1]

The same mineral types which serve to divide each of the suborders of natural silicates into well-defined tribes reappear in the non-silicated oxyds, and serve for their classification. Reserving for another occasion the details of classification of this great order of OXYDATES, we may note that while the Oxyadamantoid tribe embraces such species as periclasite, chrysoberyl, the spinels, magnetite, corundum, diaspore, hematite, quartz, rutile, cassiterite, etc.; the Oxyspathoids include cuprite, zincite, crednerite, pyrolusite, tridymite and senarmontite; and the Hydroxyspathoids, gibbsite, göthite, and manganite. Among the Oxyphylloids are brucite, pyrochroite, massicot, minium, melaconite, hydrotalcite and pyraurite; while the Oxycolloids or Opaloids embrace bauxite, limonite, opal, uran-gummite and eliasite.

§ 105. The plan of the present essay does not embrace a discussion of the species of this order, but it will be advantageous in connection with the history of the silicates, to notice some facts regarding the atomic volume of certain of these oxyds. The adamantoid tribe of the Oxydates includes a large number of species crystallizing alike in the isometric and the rhombohedral systems, which give for V a value approximating to that of the adamantoid silicates, chrysolite, pyroxene, garnet, epidote, beryl and tourmaline. Ch. Gerhardt, in 1847, published a note on "The Atomic Volume of some Oxyds of the Regular System," which was translated and given in English by the present writer in the same year.[2] Therein accepting the view held by Laurent (§ 27) of an indefinite or unlimited divisibility of the molecule, Gerhardt proposed to reduce to a common formula M_2O, (m_2o_2 of our present notation) not only protoxyds like periclasite, and protoperoxyds like the spinels, magnetite, chromite and franklinite, but sesquioxyds like martite, hematite, and braunite, and titanates like perofskite and menaccanite, including thus not only isometric and rhombohedral, but tetragonal forms. In the fractional formulas then proposed by him were employed the atomic values for aluminium, ferricum, chromicum and titanium, which have since been adopted by the writer (§ 68). For all of the species above named, reduced to his common formula of M_2O, Gerhardt deduced atomic volumes varying from 10.6 to 11.4, which, divided by two, to correspond with our chemical unit, give for the value of V from 5.30 to 5.70. These variations were ascribed by Gerhardt to errors in the determinations of density, to impurities, and to the difficulty of taking into account small portions of various oxyds present, and he conceived that for all of these species the atomic

[1] See, for a further discussion of this subject, the writer on the Origin of Crystalline Rocks; Trans. Roy. Soc. Canada, Vol. ii. Sec. 3. pp. 55–57.

[2] Ann. de Pharmacie, 1847, xii, 381–385, and Amer. Jour. Science, 1847, iv. 405–408; see also *Ibid.*, 1852, xiii. 370–372, where the same subject was further discussed by the present writer.

volume, if correctly determined, would be the same. He, however, pointed out that in these oxyds, as in organic compounds, examples of polymerism might be looked for, and cited as examples cuprous and arsenious oxyds which (like zincite and tridymite) have volumes which are much greater. Gerhardt, however, left untouched the question of the molecular weights of these more or less condensed oxyds thus compared by him.

§ 106. Near in condensation to the great group of oxyds thus studied by Gerhardt, is the rhombohedral species, quartz, which with D, 2·65, gives V, 5·66, while the tetragonal cassiterite, D, 6·75, gives V, 5·55. Coming next to titanic oxyd, we find for the tetragonal rutile, and the orthorhombic brookite alike, with D, 4·20, a value for V of 4·88; while the tetragonal octohedrite, if we take D, 3·82, (which is also near that assigned by several observers to arkansite) gives for V, 5·36. A still more condensed molecule than that of rutile appears in the rhombohedral corundum, which with D, 4·00, gives V, 4·25, while the hydrous adamantoid diaspore, orthorhombic in form, if we take its maximum observed specific gravity, 3·50, gives for V, 4·28. Near to these is the orthorhombic protoperoxyd, chrysoberyl, which, with D, 3·80, gives V, 4·18. Thus rutile and brookite are near in atomic volume to spodumene, sapphirine, staurolite, andalusite, fibrolite, bucholzite and zircon, (V = 4.80–4·90), while cassiterite and quartz are near to the spinel group, and to chrysolite, pyroxene, garnet, epidote, beryl and lyncurite. Corundum, diaspore and chrysoberyl stand apart from all of these as having a more condensed molecule than even cyanite and xenolite, the most highly condensed silicates known.

§ 107. While small differences in atomic volume may, as Gerhardt insisted, be set down to impurities and errors in determination, a careful survey of many silicates and oxyds leads to the conclusion that among these there are great groups which, essentially agreeing among themselves in molecular condensation, differ in the value of V from other groups by quantities less than those admitted as accidental variations in volume in the large series brought together by Gerhardt; which may thus very well be found to include two or more distinct groups with unlike volumes. At the same time, the comparisons which we have here made among the adamantoid oxyds, not less than those among the various tribes of silicates, serve to strengthen the conviction that the accident of geometric form, however valuable as a means of diagnosis, is of altogether minor importance in investigating the general relations of mineral species.

§ 108. The metals proper, together with the bodies of the sulphur and the arsenic series, and the various binary and ternary compound of all these, make up the great natural order of METALLATES, which includes two suborders. Of these the first or *Metallometallates*, distinguished by opacity and metallic lustre, is divided into six tribes, which are:—1. Metalloids,—native metals and metal-like elements; 2. Galenoids,—argentite, galenite, bornite, chalcocite, metacinnabar, onofrite, stibnite, etc.; 3. Pyritoids,—pyrite, linnæite, chalcopyrite, pyrrhotite, etc.; 4. Smaltoids,—smaltite, niccolite, breithauptite, with other arsenids, antimonids, etc.; 5. Arsenopyritoids,—including arsenopyrite, cobaltite, etc.; 6. Bournonoids,—enargite, bournonite, zinkenite, etc. The various selenids and tellurids form subtribes distinct from the sulphurous or Thiogalenoids. In the second suborder are included those species more or less resinous or adamantine in lustre, generally red in color or in streak, and often transparent or translucent, whence the distinctive name of *Spathometallates*. In this suborder we distinguish at least two tribes: 1. Sphaleroids,—corresponding to galenoids, and including cinnabar, realgar, christophite, marmatite,

sphalerite, greenockite and hauerite; 2. Proustoids,—corresponding to bournonoids, and embracing proustite and other red silver ores, tetrahedrite, livingstonite, dufrenoysite, binnite, etc. It is worthy of notice that while sulphid of mercury, in the forms of metacinnabar and cinnabar, appears in both suborders of the Metallates, the sulphid of antimony is also represented among the Spathometallates by the well-known red and generally uncrystalline kermes. The various forms of sulphur and of phosphorus, together with vitreous selenium, will constitute a third tribe of the second suborder of Metallates. The Spathometallates, as seen in their typical forms, sphalerite, wurtzite, greenockite, cinnabar, proustite, etc., serve, through the sulphoxydates, kermesite and voltzite, and through sulphosilicates like helvite and danalite, to connect the order of Metallates with spathoid Oxydates and Silicates.

§ 109. In these various tribes the relations of hardness to condensation are not less apparent than in Silicates and Oxydates. Dividing the simplest atomic formula of the complex Metallates by the number of atoms, we get, as the most convenient term for comparison, the mean weight of the elemental unit from which to deduce the volume, V. We thus find for the pyritoids, pyrite and marcasite, values for V of 4·0 and 4·2; for linnæite, 4·4; for pyrrhotite and chalcopyrite, 5·0 and 5·3; and for alabandite, 5·4. The smaltoids, niccolite and smaltite, give 4·4 and 5·1; the arsenopyritoids, cobaltite and gersdorffite, from 4·3 to 4·6; the thiogalenoids, for chalcocite, 7·0; for stibnite, 7·4; for galenite, 7·9; and for argentite, 8·5. Of the sphaleroids, hauerite gives 5·7; sphalerite, 6·0; and other species, 7·0–7·4. The contrasts between the last two tribes and the preceding three, alike in their hardness, and in their condensation, as shown in the different values of V, are apparent; and these are not less marked when the hard and dense arsenopyritoids are compared with the chemically analogous, but softer, bournonoids and proustoids. Of the former of these, enargite gives for V, 6·9, and bournonite, zinkenite and jamesonite, 7·7–7·8; while of the proustoids, miargyrite, proustite, pyrargyrite and polybasite give from 8·0 to 9·0, and dufrenoysite, and tetrahedrite, from 7·2 to 8·3. By reason of the variations in the recorded specific gravities of most of the species compared, the values here given for V must be regarded as but approximations to be corrected with the help of more exact determinations.

§ 110. The native compounds of the haloid elements may be included under the order HALOIDATE, with the four suborders of *Fluorid*, *Chlorid*, *Bromid* and *Iodid*. Titanates, niobates, tantalates, tungstates, molybdates, chromates, vanadates, antimonates, arsenates, phosphates, nitrates, sulphates, borates, carbonates and oxalates constitute as many distinct orders. Of these the soluble chlorids, sulphates, borates, carbonates, etc., belonging to the salinoid type, form tribes under their respective orders, as Chlorosalinoid, Sulphatosalinoid, Borosalinoid and Carbosalinoid. The native combustible carbons and hydrocarbonaceous bodies are included in a single order, which, from the fire-making property of these may be aptly designated as the order of PYRICAUSTATES. This is divided into two suborders: 1. *Carbates*, including the phylloid, graphite, and the adamantoid, diamond, representing two tribes; and 2. *Carbhydrates*, which may be conveniently grouped in the four tribes, Naphthoid, Asphaltoid, Resinoid and Anthracoid.

§ 111. It is impossible to arrange in a single line the whole of the orders of natural mineral species in such a manner as to show their affiliations. If, however, we place consecutively in a horizontal line the three orders of Metallate, Pyricaustate and Haloidate, the second of these will form the summit of a vertical column, in which, beneath the

Pyricaustates, may be placed successively all the other orders: Oxydate, Silicate, Titanate, Niobate, Tantalate, Tungstate, Molybdate, Chromate, Vanadate, Antimonate, Arsenate, Phosphate, Nitrate, Sulphate, Borate, Carbonate and Oxalate;—an arrangement of these orders of oxydized compounds in which general physical characters have been considered. The Metallates, standing above, on one side, are connected with the vertical column by the sulphuretted carbhydrates, by sulphuretted oxyds like kermesite and voltzite, and by sulphosilicates like helvite and danalite. The Haloidates, on the other side, are connected with the same vertical column by the oxychlorids, by chlorosilicates and fluorosilicates like sodalite, pyrosmalite, tourmaline, chondrodite and topaz, and by the haloid elements in certain arsenates, phosphates, borates and carbonates. The affiliations between the orders in the vertical column are seen in titanosilicates like titanite and astrophyllite, in niobosilicates like wöhlerite, in sulphatosilicates like hauÿne, in borosilicates like datolite and tourmaline, and in carbosilicates like cancrinite. Of these orders, Metallates, Pyricaustates and Haloidates will each constitute a Class,—all the remaining orders being included in another Class.[1]

These four classes with their orders and suborders may be tabulated as follows:—

Classes.	Orders and Suborders.
I.	1. Metallates: *a.* Metallometallates; *b.* Spathometallates.
II.	2. Oxydates.—3. Silicates: *a.* Protosilicates; *b.* Protopersilicates; *c.* Persilicates.—4. Titanates.—5. Niobates.—6. Tantalates.—7. Tungstates.—8. Molybdates.—9. Chromates.—10. Vanadates.—11. Antimonates.—12. Arsenates.—13. Phosphates.—14. Nitrates.—15. Sulphates.—16. Borates.—17. Carbonates.—18. Oxalates.
III.	19. Haloidates: *a.* Fluorids; *b.* Chlorids; *c.* Bromids; *d.* Iodids.
IV.	20. Pyricaustates: *a.* Carbates; *b.* Carbhydrates.

§ 112. The conceptions of high molecular weights in mineral chemistry, and of the existence of compounds like polycarbonates and polysilicates made up of a great many chemical units, and including a large number of basic atoms, taught by the writer in 1853

[1] Weisbach, the successor of Breithaupt at Freiberg, published in 1875, in his Synopsis Mineralogica, a modification of the system of Mohs. Class I of Weisbach, Hydrolyte or Salts, includes compounds soluble in water; while Class II, Lithe or Stones, is divided into three orders: 1. Kuphoxyde; 2. *Pyritite* (silicate), including four families: *a.* Sklerite; *b.* Zeolite; *c.* Phyllite; *d.* Amorphite; and 3. *Apyritite* (non-silicate). Class III, Metallite or Ores, is divided into four orders: 1. *Halometallite;* 2. *Metalloxyde;* 3. *Metalle;* 4. *Thiometalle,* the last including three families: *a.* Pyrite; *b.* Galenite (Glances); *c.* Cinnabarite (Blendes). Class IV, Kauste or Combustibles, includes five orders: 1. *Ametalle* (Sulphur); 2. *Anthracite* (Coals); 3. *Asphaltite* (Pitches); 4. *Rhetinite* (Resins); 5. *Paraffine* (Waxes). The silicates of heavy metals are placed in Class III, but with these exceptions the Sklerite include the spathoids and adamantoids, the Phyllite the phylloids, and the Amorphite the colloids of our three

and 1854, and then illustrated by the carbon-spars, pyroxenes, feldspars and tourmalines —are now only, after a whole generation, beginning to be recognized by chemists. The first step in this argument is believed to have been the conclusion then deduced from the study of equivalent volumes,—that the law of condensation already known in gases and vapors applies also to solids; "so that their equivalent weights, as in the case of vapors, are directly as their densities, and the equivalents of mineral species are as much more elevated than those of the carbon series as their specific gravities are higher." By reference to the context of this, as already cited in § 15, it will be seen that a notion of the importance of geometric form in conditioning density, was then entertained by the writer, which led him, in his paper published a few months later in 1853, on the Constitution and Equivalent Volume of Mineral Species (§ 17-18) to suppose the existence of differences between the volumes of isometric, rhombohedral and various prismatic species. This notion was, however, soon afterwards discarded, as may be seen from the citations from his paper of 1867 already given in § 12-14.

§ 113. In further illustration of the supposed relations of density and equivalent, the following additional passage is quoted from the paper last cited: "There probably exists, between the true equivalent weights of non-gaseous species and their densities, a relation as simple as that between the equivalent weights of gaseous species and their specific gravities. The gas or vapor of a volatile body constitutes a species distinct from that same body in its liquid or solid state, the chemical formula of the latter being some multiple of the first; and the liquid and solid species themselves often constitute two distinct species, of different equivalent weights. In the case of analogous volatile compounds, as the hydrocarbons and their derivatives, the equivalent weights of the liquid or solid species approximate to a constant quantity, so that the densities of those species in the case of homologous or related alcohols, acids, ethers and glycerids, are subject to no great variation. These non-gaseous species are generated by the chemical union or identification of a number of volumes or equivalents of the gaseous species, which number varies inversely as the density of these species. It follows from this that the equivalent weights of the liquid and solid alcohols and fats must be so high as to be a common measure [multiple] of the vapor-equivalents of all the bodies belonging to these series. The empirical formula $C_{114}H_{110}O_{12}$, which is the lowest one representing the tristearic glycerid (ordinary stearine) is probably far from representing the true equivalent weight of this fat in its liquid or solid

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suborders of Silicates, arranged in part crystallographically and in part chemically. The Oxydates are divided between the Kuphoxyde and the Metalloxyde, or those of the lighter and the heavier metals. In Halometallite are found the silicates of yttrium, zirconium, thorium, cerium, zinc, copper, iron and manganese, together with niobates, tantalates, tungstates, chromates, as well as arsenates, phosphates, sulphates, carbonates, fluorids and chlorids of the heavy metals; the corresponding compounds of the lighter metals coming under the order Apyritite of Class II. In a second edition of the Synopsis, in 1884, the Halometallite are made an order in a new class, called *Metallolithe* or Metalstones; while the order *Asphaltite* is divided by separating from it the order *Elaoite* (Petroleums). In the order of *Thiometalle*, the family Pyrite includes alike the pyritoids, smaltoids, and arsenopyritoids; Galenite, the galenoids and bournonoids, and Cinnabarite, the sphaleroids and proustoids.

From the point of view chosen for our essentially chemical system it seems unnatural to place in two distinct classes analogous and closely related oxyds, silicates, carbonates, etc. Again, the different degrees of condensation, as shown in atomic volume, and in the relations of this to hardness and susceptibility to chemical change, which underlie the distinction between spathoids and adamantoids, must not be lost sight of. It may be further remarked that instead of making, as Mohs and Wiesbach have done, solubility in water and sapidity the ground of a class-distinction, we subordinate it to the order, constituting such soluble species tribes of their respective orders.

state; and if it should hereafter be found that its density corresponds to six times the above formula, it would follow that liquid acetic acid, whose density differs but slightly from that of fused stearine, must have a formula and an equivalent weight about one hundred times that which we deduce from the density of acetic acid vapor, $C_4H_4O_4$."

§ 114. In the papers of 1853 the equivalent or molecular weights assigned by me to mineral species were confessedly arbitrary. Taking as a term of comparison the formulas of such well known species as the alums, the orthophosphates of soda, ferrocyanid of potassium, lactose, the compound of glucose and sodium-chlorid, (the empirical equivalents of which were doubled to compare with that of piperine,) minimum molecular weights were adopted for the various polycarbonates and polysilicates which it was sought to compare in volume with the species just named. Thus it was that in the notation of the time the formulas and molecular weights of the rhombohedral carbon-spars, smithsonite and calcite were represented respectively by $C_{40}Zn_{40}O_{120} = 2500$, and $C_{30}Ca_{30}O_{90} = 1500$; and those of the polysilicates, spodumene and diopside, by $si_{60}(al_{24}Li_4Na_2)O_{90} = 1400$, and $si_{52}(Ca_{13}Mg_{13})O_{78} = 1404$. The question of the relations of these provisional formulas and provisional weights to the still higher and as yet unknown values which belong to these species was left untouched. These silicates and carbon-spars are, so far as known, incapable of any chemical combinations or decompositions but such as affect their more or less complete resolution, and at the same time afford no guide to the molecular constitution of the species.

§ 115. We have already noticed the partial adoption of the notion of polysilicates in 1860 by Ad. Wurtz, who did not, in any way consider the great problem of their molecular weights, or their specific gravities. Meanwhile, however, the arguments adduced by me in 1853 in favor of high molecular weights have been strengthened by discoveries which serve to show the wide application of the analogies then drawn from the chemistry of the carbon series. First among them may be noticed the various artificial crystallized cobalt compounds, such as the potassio-cobaltous nitrite, to which was assigned a formula with Co_2K_6 and N_{12}, and a unit-weight of 958. More remarkable still are the ammonio-cobalt bases, studied by Frémy and other chemists, but made more completely known by the elaborate researches of Wolcott Gibbs and F. A. Genth in 1857. Among these may be noted the chlorid of purpureo-cobalt of the latter chemists, tetragonal in form, with a specific gravity of 1.802, which includes in its formula, with Co_2, not less than Cl_6 and N_{10}, and has a unit-weight of 501; the chlorid of luteo-cobalt of Frémy, clinorhombic in form, with specific gravity 1.701, which with the same proportions of cobalt and chlorine contains not less than N_{12}, and has a unit-weight of 535; and, finally, the orthometaphosphate of luteo-cobalt of Braun, for which is deduced a formula including Co_6 and N_{36}, with P_{10}, giving a unit-weight of 2540.[1] These numbers, like those deduced for alums, ferrocyanids, sugars, and alkaloids, represent the weight of the chemical units of which the species are supposed to be in all cases polymeres, the molecular weights of which are as yet unknown.

§ 116. Still farther light has, however, been thrown on the subject of polybasic salts of great complexity by the studies of the compounds of tungsten and molybdenum.

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[1] See Gibbs and Genth, Smithsonian Contributions, ix. 1857, and Amer. Jour. Science, xxiii-xxiv; also farther Gmelin-Kraut, Handbuch, iii. *sub voce* "Kobalt."

It was in 1861 that Marignac made known the existence of two types of silicotungstates, in which one molecule of SiO_2 is united respectively with ten and twelve molecules of WO_3. Subsequent studies by Scheibler, made us acquainted with series of phosphotungstates in which six molecules and twenty molecules of WO_3 are united with one of P_2O_5; while Henri Ste-Claire Deville and Debray made known analogous phosphomolybdates. Wolcott Gibbs has resumed tbe study of these various compounds, designated by him "Complex Inorganic Acids," and has greatly extended our knowledge of them. He now recognizes a series of metatungstates, the lowest of which, considered as an acid, is $4WO_3 . H_2O$, and the highest $16WO_3 . 7H_2O$; while he finds not less than ten phosphotungstates, constituting a homologous series; "the homologizing term" being $2WO_3$, the extremes $6WO_3 . P_2O_5 . 6H_2O$, and $24WO_3 . P_2O_5 . 6H_2O$, and the salts apparently 12-basic. Similar series are got for molybdenum, and arsenic, vanadic and antimonic oxyds may replace the phosphoric oxyd in these compounds. Hypophosphorous and phosphorous and metaphosphoric acids may also take the place of phosphoric acid in these complex salts, and portions of the oxygen in molybdic and tungstic oxyds may be replaced by fluorine, while hydrocarbon radicals like ethyl, methyl, and phenyl, appear also to be capable of entering into the compounds.

§ 117. The silicotungstates of Marignac have also been the subject of farther generalization by Gibbs, and it is found that the molecule of silica therein may be replaced by the oxyds of platinum, selenium and tellurium, etc. The oxyds of tin, titanium, zirconium, niobium and tantalum also appear to form similar combinations with the tungstates and molybdates. All of these series of salts are soluble in water and crystallizable, generally assuming clinorhombic or anisometric forms. Nor are these complex salts confined to the compounds of tungsten and molybdenum; Gibbs has found several new series made up from vanadic with phosphoric or arsenic acid, one of which he represents by $20V_2O_5 . P_2O_5 . 6H_2O+53\ H_2O$, and he concludes that "these complex inorganic acids form a new department of inorganic chemistry, and not a series of isolated compounds."

§ 118. With regard to all such complex species, Gibbs justly remarks, "we have no positive knowledge of the composition of these salts, their molecular weights being, as in the case of most inorganic compounds, entirely unknown." He adds, that the progress of science "tends constantly to show that the structure of inorganic molecules is more complex than we formerly supposed,"[1] and illustrates the great complexity in these compounds by a phosphotungstate including vanadium and barium, represented by the formula $60WO_3 . 3P_2O_5 . 2V_2O_5 . VO_2 . 18BaO + 144H_2O$, and having in his opinion "the highest molecular weight yet observed, 20658." He describes another similar compound, $60WO_3 . 3P_2O_5 . V_2O_5, VO_2 . 18BaO + 150H_2O$, of which he says, "it is almost certainly a double or triple salt, but still shows how five different oxyds may exist in a single well-defined and beautifully crystallized compound." Besides these soluble and hydrous species, all produced in the moist way, is the curious gold-colored insoluble anhydrous crystalline body discovered by Wöhler, which is formed at a red heat, and is generally described as a tungstate of tungstous oxyd and soda. This, Gibbs suggests, may possibly be represented by $16WO_3 . 4WO_2, 7NaO$, which corresponds to a unit-weight of 5002.

[1] Wolcott Gibbs on Complex Inorganic Acids; Amer. Jour. Science, 1877, xiv. 61; also in abstract Proc. Brit. Assoc. Adv. Science, Montreal, 1884, p. 667, and more fully in Amer. Jour. Chemistry, 1879-1883, i. 1, 217; ii. 217, 281; iii. 317, 402; iv. 377; v. 361, 391.

§ 119. The researches of Gibbs in these complex inorganic acids, resuming, extending, and generalizing those of other laborers in the same field, are of much significance to the chemist in his study of natural mineral species, both by establishing the doctrine of a great complexity of molecule in similar bodies, and by showing the influence of very small portions of some one constituent in a compound. Thus the addition to twelve molecules, or 2784 parts of tungstic oxyd, of one molecule or sixty parts of silica, determines the formation of an octobasic silicotungstate, which differs notably in its chemical relations from the corresponding decabasic metatungstate, equally with twelve molecules of tungstic oxyd. In like manner, the addition to twenty-four molecules of tungstic oxyd of one of phosphoric oxyd gives rise to a new and distinct complex acid; while small proportions of very various oxyds produce other new and well defined compounds. By an analogy not too remote, we are helped to understand the part played in many natural silicates by small portions of fluorine, of chlorine, of sulphur, of sulphates and carbonates, and even of phosphates, arsenates and vanadates, which have hitherto been in many cases regarded as accidental impurities.

§ 120. The readers of the second part of this essay will recall that in putting forth in 1853, the views ever since maintained with regard to the condensation of the molecule, and the very complex structure of so-called inorganic compounds, it was affirmed that these views would not only "lead to a correct mineralogical system," but would "be found to enlarge and simplify the plan of chemical science." This latter result it was then farther shown, was to be attained by establishing, for mineral or inorganic species, complex formulas and high molecular weights, and by applying "to these bodies the laws of substitution, homology and polymerism which have long been recognized in the chemical study of the hydrocarbon series." A generation has passed since then, and chemists are now, by the methods then first indicated, advancing in this direction towards what Roscoe calls "the establishment of a systematic inorganic chemistry which needs not fear comparison with the order which reigns in the organic branch of our science." He adds, "it is well to be reminded that complexity of constitution is not the sole prerogative of the carbon compounds, and that before this systematization of inorganic chemistry can be effected we shall have to come to terms with many compounds concerning whose composition we are at present wholly in ignorance," and by way of illustration refers to the complex inorganic acids of Gibbs.[1]

§ 121. Recognizing from the beginning of this inquiry that the molecular weights of mineral species, while far exceeding those of hydrocarbonaceous or so-called organic liquids and solids, are equally unknown, we have sought, nevertheless, to show the comparative condensation in different mineral species, and at the same time the existence of homologous series among them, by the use of atomic formulas. In these the results of chemical analysis are reduced to their simplest term, and are presented independent of all hypotheses as to the structure or the molecular weight of the species. These formulas suggest to the chemist something more than the elemental atoms represented by the symbols employed. While he admits in the simplest mineral silicate or oxyd the existence of oxygen, silicon or one or more metals, all being chemical elements physically dissimilar

[1] Sir H. E. Roscoe, Address to the Chemical Section of the British Assoc. Adv. Science, Montreal, Aug., 1884, Report, p. 663.

to each other and to the species before him, the tendency of the mind is to conceive this as made up of identical or of similar units or individuals. The justification of this mental process appears in the fact that it is in the comparison of such individuals or chemical units that we find the chief data for the intelligent study of the chemical species. Such a conception of units underlies the doctrine of polymerism, and that of homologous or progressive series, and enables us to compare silicates, oxyds and carbon-spars in a manner, the correctness of which is verified by the close relations revealed between atomic weight and specific gravity. While we may take for the chemical unit either its simplest expression, or some multiple thereof, we have for convenience in the study of silicates and oxyds preferred the former, which for both of these may be represented as a compound of a monatomic elemental atom, or its equivalent, with an atom of oxygen, sulphur, fluorine or chlorine. For compounds of metals with sulphur, arsenic, antimony, etc., the elemental atom itself may be assumed as the unit. For carbonates, however, it has not seemed expedient to divide the weight of the tetrad carbon beyond that portion which in the normal carbonate is found with a univalent metal; while in complex sulphates like alum, in orthophosphates, etc., convenience suggests the less simple individuals which we have employed in these pages.

§ 122. Having adopted for all mineral silicates and oxyds the simplest conceivable chemical unit, as above indicated, the second step in our inquiry was to determine for each species, from its atomic formula, the mean weight of the unit, the atom of hydrogen being taken as one and that of oxygen at eight; this mean weight has been designated P. The next point to be considered is the relation of this chemical unit to space, a relation which is the nexus between the chemical and the physical, and is determined by dividing the mean unit-weight by the specific gravity of the species (water being unity) represented by D. The quantity thus obtained we have designated as the unit-volume or atomic volume, and have represented by V. The relations, alike of this unit-weight and unit-volume to those of the molecule to which it belongs, are unknown. But this molecule has, by our hypothesis, a constant volume, for which an expression is yet wanting, and can, so far as now known, only be attained by assuming as unity the number which corresponds to the highest discovered value of V. The true unit of molecular volume will probably still be some multiple of this quantity, and will, at the same time, be the common multiple of all the atomic volumes deduced from various chemical units.

§ 123. In approaching the consideration of this molecular volume, it may be noted that while in salts of the same type the specific gravity sometimes rises with the molecular weight of the base, as when zinc replaces magnesium, or lead, strontium in carbon-spars, the specific gravity of double or triple salts is essentially the same as that of the corresponding salts with a single base, as may be seen by comparing the densities of simple and double hydrous sulphates, orthophosphates and tartrates; so that the value of P, deduced from the more complex salts, considered as chemical units, will be essentially the same as that of the apparently simple salts of the type. Taking, then, of the ammonia-cobalt salts (§ 115), not the simple chlorids, but Braun's complex phosphate of luteo-cobalt with a unit-weight of 2540 (of which the specific gravity is undetermined), we have, if we assume for it a density of 1.076 (which is that of the chlorid of the same base), a unit-volume of not less than 1492.

§ 124. The complex tungstates give still higher volumes. The golden anhydrous

tungstico-tungstate of sodium has a specific gravity of 6.617, while for two allied tungstic compounds, the one potassic and the other sodic, are given the numbers 7.60 and 7.28, showing that these are similar in condensation to the anhydrous calcic and ferrous tungstates, scheelite and wolfram. For the soluble and hydrated polytungstates, Scheibler found the specific gravity of $4WO_3 . Na_2O+10Aq.$ to be 3.987, while that of the corresponding barium salt, with 9Aq is 4.298, and that of $14WO_3 . 6Na_2O+32Aq.$ is 3.846.[1] The density of the complex hydrous phospho-vanadio-tungstate of barium described by Gibbs (§ 114) with a unit-weight of 20058, is unknown, but, if we assume for it the number found by Scheibler for the hydrous barytic metatungstate, we have a unit-volume of not less than 4666, or more than three times the volume of the cobalt salt. What greater unit-volume than this can be determined remains for the chemist to discover, but it should be considered that such elevated unit-weights as that last mentioned are not readily attained, save with a few elements of high atomic weight, such as tungsten, vanadium and barium. Moreover, with elements of lower atomic weight the difficulty of fixing definite formulas for their compounds is notably increased, so that the remarkable results obtained by Gibbs may, for a long time to come, mark the limits of the chemist's skill in this direction of research.

§ 125. If then, as we have argued, the molecules of mineral species are so complex, and their minimum molecular weight is so large that their volume may be represented by a sum not less than about 4666, or more probably some multiple thereof, it follows that a silicate like pyroxene, for the simplest atomic unit of which we have found a volume of about 5.5, must include in its molecule not less than 848 such atomic units, and wollastonite, with a corresponding volume of 6.6, about 700. But as our simplest atómic formula for these species embraces three of these units, $(m_1si_2)o_3$, it will be evident that with the molecular volume of 4666, here assumed, the constitution of pyroxene may be represented very nearly by $282(m_1si_2)o_3$, and that of wollastonite by $236(m_1si_2)o_3$. In like manner, the atomic volume of the feldspars, anorthite and albite, approximately represented by 6.3, is contained in our assumed molecular volume 742 times. The simplest atomic formula for anorthite being $(ca_1al_3si_4)o_8$, and for albite $(na_1al_3si_{12})o_{16}$, the constitution of anorthite may be represented by $92(ca_1al_3si_4)o_8$ and that of albite by $46(na_1al_3si_{12})o_{16}$; while for orthoclase and microcline, with a unit-volume of 6·8, we deduce a formula of $42(k_1al_3si_{12})o_{16}$.

It will be evident that attempts like these at molecular formulas are of value only so far as they serve for illustration, since the unit-volumes assigned to the various species are but approximations, and the molecular volume, 4666, which has been assumed, is based on a supposed specific gravity, and can only be conjectured to be not far from the truth. A series of careful studies of the specific gravities of various salts of the complex inorganic acids may furnish us with more trustworthy data for similar calculations. Meanwhile, it is to be repeated that the formulas here given for pyroxene, wollastonite, and the feldspars, are of value only as they serve to illustrate our conception of the complex constitution of these silicates. For the purposes of comparison, and for the elucidation of polymerism and homologies, the unit-volumes which we have calculated for the preceding tables of species of the different tribes of silicates, serve every purpose, and show in a simple manner the relative condensation of the molecule in the

[1] See Constants of Nature, by F. W. Clarke, Part i. 83.

various species. Attempts to devise structural formulas for these very complex silicates appear in the present state of our knowledge of their constitution to be premature, and at the same time unnecessary.

§ 126. We have seen in our studies of the volume of mineral species two cases; the first being that in which, in analogous compounds, the density varies with the unit-weight, so that the species compared have identical unit-volumes; and the second, that in which species, otherwise analogous, have such densities as give very unlike unit-volumes,—a fact showing the existence of progressive or homologous series of polymeres, as illustrated in the case of many silicates and carbon-spars. Examples of these differences are seen in the chlorids of potassium and sodium, the latter of which itself presents remarkable differences in density. Thus, while the numerous determinations for potassium-chlorid do not vary very much from a specific gravity of 1.99, the careful observations of different experimenters with sodium-chlorid, show variations from 2.011 by Playfair and Joule, to 2.15–2.16 by Stolba, 2.195–2.204 by Deville, and 2.24–2.26 by Mohs and Filhol.[1] With these various determinations of density before us, says Henry Wurtz, "we are forced to infer the existence of four modifications of sodium-chlorid," while he adds, "common salt is far from being alone among saline combinations in its passage into divers modifications or allotropes. On the contrary, the circumstance is almost universal among salts, throughout the whole range of chemistry." It would seem, in fact, that such variations in specific gravity in a homogeneous solid (like those in the specific gravity of a vapor or gas, at constant pressure and temperature,) can have but one meaning; which is, that these sodium-chlorids of different densities are so many distinct species, related to each other as fibrolite to cyanite, as lyncurite to zircon, and as tridymite to quartz.

§ 127. All such allotropic variations in compound species, which are marked not only by differences of density, but in many cases, if not in all, by differences in hardness and in chemical relations, are, by Henry Wurtz conceived to be, "dependent on a variability through a certain—sometimes not very narrow—range of diameters of one element, always the basylic or electropositive of a group—in salts, therefore, always the metallic base." According to him, the volumes of elemental molecules, that of oxygen excepted, "are expressed by quantities having at the temperature of ice-fusion the relations of even cubes of a series of whole numbers, of which series the number pertaining to the molecule of ice at this temperature is 27." This, he adds, is "a standard volume in nature, to which the volumes of all liquid and solid bodies may be compared when at the same temperature." The cube roots of these numbers are by Wurtz, designated as "molecular diameters," and the variations in specific gravity in the different forms of sodium-chlorid, are explained by supposing the diameters of one or more of the sodium molecules in a complex group including 4NaCl., to vary from 23 to 24 and 25, the diameter of the chlorine molecules remaining invariable.[2] This method enables him, by admitting more or less complex groups, in which the similar elemental molecules have varying diameters, to approximate closely to the densities of liquid and solid species.

§ 128. To such a scheme it may be objected that it involves the notion of pre-existing elements or groups of elements, dissimilar to each other as well as to the species under

[1] Constants of Nature, by F. W. Clarke. Part i. 30.

[2] Geometrical Chemistry, by Henry Wurtz, pp. 72, 1876; reprinted from the American Chemist, March, 1876.

examination. The conception that the chemical elements enter as such into combination, and there retain their volumes is, however, I believe, inadmissible in chemical philosophy, The view which I have constantly maintained, and have set forth in the present essay, is that differences in density, such as we have just considered, are not dependent on variations in the hypothetical units adopted for convenience in calculation, but belong to the species as an integer, and correspond to a greater or less condensation of its mass; that is to say, to the identification in a constant volume of a greater or less number of chemical units. The very terms of atom and molecule, which we apply to these imaginary units and to the mass, are concessions to a popular terminology borrowed from physics, and are not only inadequate but to a certain extent misleading when applied to chemical operations. I venture in this connection to reprint the words employed in 1874,[1] in the discussion of this same question:—

"The phenomena of chemistry lie on a plane above those of physics, and, to my apprehension, the processes with which the latter science makes us acquainted can afford, at best, only imperfect analogies when applied to the explanation of chemical phenomena, to the elucidation of which they are wholly inadequate. In chemical change, the uniting bodies come to occupy the same space at the same time, and the impenetrability of matter is seen to be no longer a fact; the volume of the combining masses is confounded, and all the physical and physiological characters which are our guides in the region of physics fail us, gravity alone excepted; the diamond dissolves in oxygen gas, and the identity of chlorine and of sodium are lost in that of sea-salt. To say that chemical union is, in its essence, identification, as Hegel has defined it, appears to me the simplest statement conceivable. The type of the chemical process is found in solution, from which it is possible, under changed physical conditions, to regenerate the original species. Can our science affirm more than this, and are we not going beyond the limits of a sound philosophy when we endeavor, by hypotheses of hard particles with void spaces, of atoms and molecules, with bonds and links, to explain chemical affinities; and when we give a concrete form to our mechanical conceptions of the great laws of definite and multiple proportions to which the chemical process is subordinated? Let us not confound the image with the thing itself, until, in the language of Brodie, in the discussion of this very question, 'we mistake the suggestions of fancy for the reality of nature, and we cease to distinguish between conjecture and fact.'"

§ 129. We here terminate for the present the discussion of the principles which, as we have claimed, serve "to enlarge and simplify the plan of chemical science," and, as a necessary result thereof, to form the basis of a Natural System in Mineralogy. We have endeavored to set forth in some detail the application of these principles to the Silicates, and more briefly to the non-silicated oxyds, which we have included in the order of Oxydates, as well to the order of Metallates. We have, moreover, given (§ 110, 111) an outline of a system of classification which embraces all natural mineral species. It is here the place to repeat the language employed in 1867, and already cited in § 13: that all chemical species really belong to the mineral kingdom, and that "in this extended sense, mineralogy takes in, not only the few metals, oxyds, sulphids, silicates,

[1] A Century's Progress in Theoretical Chemistry; being an address at the grave of Priestley, July 31, 1874, reprinted from the American Chemist for August and September, 1874. See also "The Domain of Physiology," L. E. and D. Philos. Mag., October, 1881, § 18, 19.

and other salts which are found in nature, but also all those which are the products of the chemist's skill. It embraces, not only the few native resins and hydrocarbons, but all the bodies of the carbon series made known by the researches of modern chemistry." A Manual of Mineralogy, based on the principles here set forth, such as we hope to prepare, would however be limited to the consideration of natural species.

§ 130. In conclusion, we give three synoptical tables in which are resumed, under their respective tribes, the principal species of the three suborders into which we have

Suborder I. PROTOSILICATE.

m : si.	1. PECTOLITOID. **V = 7·0—5·3**	2. PROTOSPATHOID. **V = 6·7—6·0**	3. PROTADAMANTOID. **V = 6·0—4·6**	5. OPHITOID. **V = 7·3—5·5**
1 : ¾	- - -	Danalite (**7 : 6**). - - -	Chondrodite.	
1 : 1	Calamine. Thorite. Cerite. -	Willemite. Knebelite. Batrachite. Tephroite. Gadolinite. Helvite.	Monticellite. Chrysolite. Phenacite. Bertrandite.	
1 : 1¼	Chrysotile. - - -	Leucophanite. - - -	- - -	Serpentine. Retinalite.
1 : 1½	Gyrolite. Friedelite. Pyrosmalite. - - -	- - -	- - -	Deweylite. Genthite.
1 : 2	Xonaltite. Plombierite. Hydrorhodonite. Dioptase.	Wollastonite. Tscheffkinite. - - -	Amphibole. Rhodonite. Pyroxene. Enstatite. -	Aphrodite. Cerolite. Chrysocolla. -
1 : 2⅔	Pectolite. - - -	- - -	Amphibole. - - -	Spadaite.
1 : 2½	- - -	- - -	- - -	Rensselaerite.
1 : 3	- - -	- - -	- - -	Sepiolite. Glauconite.
1 : 3½	Datolite.			4. PROTOPHYLLOID.
1 : 4	Apophyllite. Okenite. - -	- - -	Guarinite. Titanite.	
1 : 7	- - -	- - -	Danburite.	Thermophyllite (**3 : 4**). Talc (**2 : 5**). Talc (**2 : 6**).

Suborder II. PROTOPERSILICATE.

m : *m* : si.	6. ZEOLITOID. **V = 7·2—6·3**	7. PROTOPERSPATHOID. **V = 8·6—6·1**	8. PROTOPERADAMANTOID. **V = 5·8—4·7**		9. PROTOPERPHYLLOID. **V = 6·2—5·1**	
				TOURMALINES.	MICAS.	
1 : ½ : n	- - -	Melilite. Eudialyte. -	Pargasite. Keilhauite. - - -		Phlogopite. -	CHLORITES. A large group of hydrous magnenesian species.
1 : ¾ : n	- - -	Wöhlerite. Ilvaite. -	Idocrase. Schorlomite (**4 : 3**). - - -		Phlogopite. -	
1 : 1 : n	Xanthorthite.	Gehlenite. Sarcolite. Milarite. - - -	Garnet. Ægirite. Allanite. Beryl. -		Biotite. - -	
1 : 1½ : n	Prehnite. - -	Barylite. - - -	Euclase. Ardennite. Arfvedsonite. -		Seybertite.	10. PINITOID.
1 : 2 : n	Hamelite. Catapleiite.	Scapolites. Sodalites.	Axinite. Epidote. Zoisite. Jadeite. Acmite. - - -		Willcoxite. -	Jollyte.
1 : 3 : n	ZEOLITES. - -	FELDSPATHIDES. - - -	- - -	Coronite.	Zinnwaldite.	Fahlunite. Bravaisite.
1 : 4 : n	Edingtonite. Sloanite.	Petalite. - - -	Spodumene. Sapphirine. Staurolite. - - -	Schorlite.	Lepidolite. -	Hygrophilite (**1 : 5**).
1 : 6 : n	Forestite. -	- - -	- - -	- - -	Margarite. Muscovite.	
1 : 8 : n	- - -	- - -	- - -	Aphrizite.	Euphyllite.	Pinite.
1 : 9 : n	- - -	- - -	- - -	Indicolite.	Damourite. Muscovite.	Cossaite.
1 : 12 : n	- - -	- - -	- - -	Rubellite.	Muscovite.	(Palagonite. Tachylite. Pitchstone. Obsidian.)
					(With other species).	

divided the order of SILICATES. In these tables the principal atomic ratios are given in the left-hand columns, while more rarely recurring ratios, as in danalite, schorlomite, sloanite, etc., are placed in parentheses after the names of the species, which are in their appropriate positions in their respective columns. In the case of Tribe 4, the exigencies

Suborder III. PERSILICATE.

m : si.	11. PERZEOLITOID. V = ——	12. PERSPATHOID. V = ——	13. PERADAMANTOID. V = 5·7—4·4	14. PERPHYLLOID. V = ——	15. ARGILLOID. V = 6·5—5·4
1 : ¼	- - - - - - -	- - - - - - -	- - - - - - - - - - - - -	- - - - - - - - -	Schrötterite.
1 : ⅓	- - - - - - -	- - - - - - -	Dumortierite. - - - - - - -	- - - - - - - - -	Collyrite.
1 : ⅔	- - - - - - -	- - - - - - -	Topaz. Andalusite. Fibrolite. Cyanite. Wörthite (6 : 5). -	- - - - - - - - -	Allophane.
1 : 1	Westanite. - - -	- - - - - - -	Bucholzite. Xenolite. Lyncurite. Zircon. Malacone.	Pholerite. Talcosite (5 : 6).	Samoite.
1 : 1⅓	- - - - - - -	- - - - - - -	- - - - - - - - - - - - -	Kaolinite. - - - -	Kaolin. Halloysite.
1 : 1½	- - - - - - -	- - - - - - -	Auerbachite. - - - - - - - -		
1 : 2	- - - - - - -	- - - - - - -	- - - - - - - - - - - - -	Pyrophyllite. - - -	Keramite. Wolchonskoite.
1 : 2½	- - - - - - -	- - - - - - -	- - - - - - - - - - - - -	Pyrophyllite. - - -	Montmorillonite. Chloropal.
1 : 3	- - - - - - -	- - - - - - -	Anthosiderite. - - - - - - -	- - - - - - - - -	Cimolite.
1 : 4	- - - - - - -	- - - - - - -	- - - - - - - - - - - - -	- - - - - - - - -	Smectite.

of construction have caused its displacement in the table, and hence the atomic ratios of its included species are there also appended. The calculated values of V are given with the respective tribes. These tables are necessarily much abridged, and should be studied in connection with the systematic grouping of suborders, tribes and species to be found under § 55 of the present essay.

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VII.—*Tidal Observations in Canadian Waters.*

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(Read May 28, 1885.)

The subject of the following paper has both a practical and a scientific side, but as I desire to bring the practical value of tidal observations especially before you, an explanation of the origin of the paper may be useful. My attention was first drawn to the subject in its practical aspect, apart from the mere theory of the tides, by the loss of the S.S. "North Briton" near the Mingan Islands, in the Gulf of St. Lawrence. This was many years ago, before the time of Confederation, I think ; but the exact date I do not recollect. The vessel was lost in calm weather, and the first reports of the occurrence stated that the wreck must have been due to an error of the compass ; but, eventually, it was generally agreed that the true cause was an unknown current carrying the vessel out of the course in which she was supposed to be sailing. No attempt was made, so far as I know, to seek out the cause of this current, whether it was permanent or shifting, or whether any directions could be given by which other vessels might avoid a like fate.

The interest then aroused was kept up by reports from time to time of other wrecks on other parts of the Canadian coasts, said to be due to the same cause, viz., unknown currents. These, I strongly suspected, were due mainly to the tides ; but no satisfactory means of bringing the matter directly to public notice presented themselves until this Society was formed. Last year I had hoped to bring a paper on the subject before this Section, but pressure of other work prevented it. Then came the meeting of the British Association in Montreal, and it occurred to me that such an opportunity should not be lost ; the British Association had been for many years making strenuous efforts to extend tidal observations, and it would only be necessary, I felt, to call their attention to Canada's wants in this respect, in order to secure their advocacy. Probably even this may not have been necessary. At any rate, I had no sooner brought forward the subject than it was taken up warmly. A committee was at once appointed, consisting chiefly of members of this Section, to promote these observations in Canada, while the Council of the Association was requested to communicate directly with the Canadian Government. The Council of our own Society was not wanting to the occasion. It addressed a petition to Parliament in favor of a money-grant for the observations.

The direct object of this paper being to call the attention of the Society, and through the Society to arouse the public to the practical value of and urgent need for observations, it is unnecessary to dwell on the theory of the tides. Yet I cannot forbear noting that work done now is a continuation of the work begun by Newton two centuries ago, when he laid the foundations of tidal theory. For, as Dr. Whewell says in his well-known paper on cotidal lines, published in the Philosophical Transactions of the Royal Society of Lon-

don for 1833: "With regard to this alone of all the consequences of the law of universal gravitation, the task of bringing the developed theory into comparison with multiplied and extensive observations is still incomplete; we might almost say, is still to be begun."

Progress has been made since the date of Dr. Whewell's paper, more especially since the question was taken up by the British Association, at the suggestion of Sir William Thomson in 1867, and a committee was appointed for the purpose of promoting the extension, improvement and harmonic analysis of tidal observations, which committee has been continued from year to year ever since. Very much, however, remains yet to be done, and we in Canada ought to be able to take our own share in the work, whether we regard the scientific or the practical results to be expected.

Among the scientific results that may be expected from tidal investigation founded on extensive observations are :—

1. A determination of the mass of the moon; since the attraction depends on this. Some thirty years ago this mass was estimated at about one seventy-fifth part of the earth's mass. The value at present adopted is about one eighty-first part.

2. More definite knowledge of the question, which has been so interesting to geologists, concerning the rigidity of the earth.

3. The effect of tidal friction in the retardation of the earth's rotation.

4. Possibly also by the aid of Sir William Thomson's corrected equilibrium theory, an account of which is given in Thomson and Tait's "Natural Philosophy," we may get some knowledge as to the amount of water surface in the unexplored arctic and antarctic regions.

5. A more accurate knowledge of the tide-currents over the surface of the oceans.

6. The effect of the wind on the tides from meteorological observations carried on simultaneously.

The practical results in their bearing on the commerce of Canada, are those that will be valued by the greatest number, and these I purpose now to consider. Tidal observations may be divided into two classes :—

(1.) Those connected with the prediction of the height of the tide at any given place and given time.

(2.) Observations on the tidal streams or currents produced by the ebb and flow of the tide.

Both classes of observations are affected by atmospheric changes; hence, meteorological observations are associated with them.

A knowledge of the time for high and low water at a given place must precede a knowledge of the currents caused by the ebb and flow. It is therefore much to be regretted that Canada is as yet not only unprovided with tide-tables, such as the United States Government publishes yearly for its own Atlantic and Pacific coasts, but has not even possession of the facts on which to base the calculation of such tables. Let us earnestly hope that the memorial which the British Association has addressed to the Government, urging the need of establishing stations to make the requisite observations from which predictions may be subsequently calculated, may be successful. The more difficult problem of tidal currents may then be undertaken. That its solution is possible and that its practical value is great, need not be doubted. To the consideration of it, the remainder of the paper will be given.

It seems hardly necessary to remark, that it must often be a matter of vital consequence that the master of a ship should be able to ascertain at any time the "rate and set" of a current which is acting on his ship. In hazy or foggy weather, or in dark nights, when in the neighborhood of land, all the precautions that the utmost skill may dictate, and the utmost care employ, may be thrown away, if the mass of water in which his ship is floating, is itself travelling bodily in a direction unknown to him, carrying his ship to destruction. Now in general at any place, the tidal current shifts its direction four times a day according to the ebb or flow of the tide, from permanent causes, leaving out of account, for the present, atmospheric changes. It is, therefore, obvious that, in average weather, it ought to be possible, if proper investigations be made, to obtain such information for each locality (for of course, the conformation of the land, and other local circumstances must affect the current,) as would be a guide to navigators.

Accordingly we find in the British and Irish tide-tables, no less than forty pages devoted to a description of the tidal currents off the coast of the British Isles, under the headings "South Coast of England," "East Coast of Scotland and England," "West Coast of Scotland," "Tidal streams among the Orkneys, in the Irish Channel, in the English Channel, in the North Sea." For more accuracy, the English Channel and North Sea, are divided in the tables into what are called "compartments" because, as is said with reference to the English Channel, "the courses of the stream in the mixed tides are so changeable, that a very different stream will be found running at a place but little removed from another in the same portion of the Channel."

The investigations from which the recorded results have been obtained have been comparatively recent, and some of the rules to which they have led are of admirable simplicity. In a paper contained in the Philosophical Transactions of the Royal Society of London for 1848, Admiral Beechey gave an account of his survey of the currents in the Irish Channel; from which he deduced the remarkable fact that, notwithstanding the variety of times of high water throughout the channel, the turn of the stream, over all that part which may be called the fair navigable portion of the channel, is nearly simultaneous, and that this happens to correspond nearly with the times of high and of low water on the shore at the entrance of Liverpool and of Morecambe Bay. Thus the time when the stream turns at any place in the channel can be calculated simply from knowing the times of high and of low water at either of these places.

In the Philosophical Transactions for 1851, will be found another paper by the same author, in which he shows, from a subsequent survey of the English Channel and North Sea, that a similar rule holds there,—the turn of the stream depending on the times of high and low water at Dover. In passing it may be remarked, that this shows the special importance of accurate tide-gauge observations at Dover and Liverpool. The papers in the Philosophical Transactions are accompanied by charts, showing the course and rate of the tidal streams throughout the whole extent of the channels.

Now, compared with what is given in these tide-tables for the British and Irish coasts, the information for the Gulf of St. Lawrence, the coasts of Nova Scotia and of Labrador, and for Canadian waters generally, is excessively meagre. A comparison of dates will show, in a striking manner, that this might naturally be expected. Admiral Beechey's investigations were reported in 1848 and 1851. But the survey of the Gulf on which the Charts and Pilot Books in ordinary use are founded, was made by

Admiral Bayfield as far back as 1827-1834. Corrections have been introduced into them since by other naval surveyors, but the basis is still a survey which is now fifty years old,—in other words, which was made about fifteen years antecedent to the surveys of the English and Irish channels that led to such valuable results. That very much more information than at present exists should be wanted, is a reasonable conclusion; and that the consequences of ignorance should be seen in the annual wreck register, might be expected.

A very cursory inspection of the Wreck Lists, published in the Annual Report of the Minister of Marine and Fisheries, at once shews the truth of the conclusion. These lists have been published only since the year of Confederation, 1867; but the interval is quite sufficient for the present purpose. The losses recorded, under the headings of "tide" and "unknown currents," are too numerous to permit any mistake. In fact, the lists seem to me, in this case, to have attained the object for which, it is expressly said, they were originally published; namely, to indicate the causes of wrecks, and thus to suggest remedies. Such entries as, "current and fog," "snow-squall and current," "tide swept vessel out of her course," "strong currents," "force of tide," "strong tide and foggy weather," "hazy weather and strong current," speak for themselves. The vessels lost are of every class, from the small coasting schooner to the large ocean steamer. The aggregate loss from these causes, as recorded, is serious, and it may be even greater than appears. In most of the instances referred to, the vessel is said to have been "stranded." But as there are other cases of stranding, the causes of which were not discovered, it is possible that some of them may have been due to the tidal currents; thus, in the report for the year ending June, 1870, it is stated that there were thirty cases of vessels stranded during the year, "cause not known."

The lists usually give only the bare facts under a few headings, but occasionally a remark is added that is interesting; *e. g.*, in the report for 1875, with respect to the loss of the S. S. "Virgo," at St. Pierre, Miquelon, on her passage from Sydney to St. John's, Newfoundland, it is said that the course steered was exactly the same as usual, but a fog came on, and a strong current appears to have carried her on shore. The loss here was $70,000. Again, the loss of the S. S. "Cybele," from Glasgow for Montreal, on Hare Island reef, in the river St. Lawrence, on April 30th, 1879, is said to have been caused by a haze, and a current setting the ship on the reef. The amount in this case was $95,000. Referring to the loss of the S. S. "Lartington" (the vessel alone being valued at $165,000), from Quebec to London, wrecked on Anticosti, near S. W. Point Lighthouse, on November 4th, 1880, there is the following remark:—"The keeper of the S. W. Point lighthouse, Mr. E. Pope, is of opinion that the vessel was taken out of her course by a current which often occurs at spring tides, and strong south winds; and which, to his knowledge, has stranded several vessels in the vicinity of S. W. Point. This set of the current does not appear to be generally known." We have an instance of the loss of vessels of the largest class in the case of the R. M. S. "Moravian," which was stranded by "an unknown current," December 30th, 1880, on Mud Island, north of Seal Island, Nova Scotia.

The method followed by Admiral Beechey, in making his very successful surveys of the tidal currents, is given in his paper in the Philosophical Transactions for 1851. It is unnecessary to describe it here.

The heavy losses annually incurred through ignorance of these currents, have been referred to, and the practicability of obtaining the necessary knowledge has been shewn; it only remains to consider the cost, and to compare it with that of our present ignorance. The loss to the country from the loss of life it is impossible to estimate. One cannot but shudder, however, in trying to picture what might happen in the case of large passenger vessels, having accommodation for 1,000 steerage passengers or more. An accurate estimate of the cost could only be obtained from officers engaged in similar work. Still, enough can be ascertained to show how small it would be compared with the great gain to the commerce of the country. In fact, if only a single ocean steamer of moderate size were saved in a dozen of years, by the knowledge acquired, the gain to the community would possibly exceed all the money spent on the survey. Take the instance of the S.S. "Lartington," for example—a vessel of 1,136 tons, and in which the value of the vessel alone, without cargo, is set down as $165,000—or take the steamer "Cedar Grove," which was wrecked less than three years ago, viz., November, 1882, on Cape Island, Canso, causing a loss of $160,000. These are examples of what I mean by vessels of moderate size. But it must be remembered that much larger vessels are common, and are becoming more common every year. There are probably as many vessels of 4,000 or 5,000 tons "gross" tonnage now in the Canadian trade, as there were of 2,000 or 3,000 not many years ago, the cost being very great. The "Parisian," I am informed on the best authority, cost, when new, $750,000, and there are other vessels, nearly if not quite as large, in the trade; even larger vessels are being built. I will not refer to such vessels, but from a knowledge of their value we can readily understand how, in some instances, the loss of a valuable cargo, along with the vessel, may have amounted to a million of dollars; compared with even one such loss, the cost of a survey would be small.

I have heard the argument stated that this question really concerns insurance companies more than shipowners, and that the insurance companies have no reason to complain, because they make a profit on the whole. This argument would hardly be worth noticing, were it not that I believe it to be really influential in producing indifference to the subject. It is evident that the insurance companies are merely agencies for distributing the loss, which might ruin a single firm, over a larger area. The premiums paid by the shipowners are merely their contributions towards the general loss, and it is quite clear that the insurance companies, to whatever country they belong, would not carry on a losing business. If they found one particular branch a source of loss, they would certainly terminate their business there. It is hardly necessary to say this to show that the loss by wrecks of vessels coming to Canada falls inevitably on the people of Canada, and that it is therefore their interest to make it as small as possible, by supplying the usual means for diminishing the risks of navigation.

I have only to remark, in conclusion, that it is obvious that it would not be well to limit the meaning of the term, "Canadian waters," too strictly. Every year, there are serious losses to Canadian vessels, by currents that throw them on the coast of Newfoundland, more especially in St. Mary's Bay (St. Shott's.) These currents might well be subject to investigation. The tides and currents of the Pacific coast, of course, come under the heading also. Of these very little is known, and as the opening of the Canadian Pacific Railway, with the probability of a line of Trans-Pacific steamers in connection with it will no doubt make them of great importance, it will be well to prepare for this com

merce by careful survey. The process of discovering currents by indicating on a chart the places where costly ships have been wrecked by them is exceedingly expensive.

NOTE.—Since the above paper was read several wrecks, involving very heavy losses, have occurred from the cause referred to. Among these was that of the R. M. S. "Hanoverian" (gross tonnage, 4,000 tons). Within a few days of this occurrence the R. M. S. "Nestorian" (gross tonnage, 2,700 tons), had a narrow escape from the effects of an unknown current, having actually struck the land in or near St. Shott's Bay, Newfoundland, alluded to above, but getting off subsequently. The two most remarkable instances, perhaps were those of the S. S. "Brooklyn" (gross tonnage, 3,600 tons), and the S.S. "Titania" (2,200 tons gross), on the coast of Anticosti, in which, the result of the nautical inquiry shewed that the wrecks were due solely to a "deceptive mirage" and "the action of the currents influenced by peculiar conditions of the wind." All the witnesses upon oath declared that "nothing was left undone which could have been done, before or after the wreck, for the safety of life and property." The above statements are taken from the reports published at the time in the newspapers.

VIII.—*On the determination in terms of a definite integral of the value of the expression*

$$\frac{1}{\lfloor m+n}\left\{\left(x+\frac{n}{2}\right)^{m+n}-n\left(x+\frac{n}{2}-1\right)^{m+n}_{\cdots}+(-1)^{r}\frac{\lfloor n}{\lfloor n-r\,\lfloor r}\left(x+\frac{n}{2}-r\right)^{m+n}_{\cdots}+(-1)^{n}\left(x-\frac{n}{2}\right)^{m+n}\right\}$$

the series to be continued only as long as the quantity raised to power, m + n, *is positive,* n *being a positive integer, and* m *a positive integer, zero, or a negative integer numerically less than* n ; *and on the deduction therefrom of approximate values in certain cases. By* CHARLES CARPMAEL, **M.A.**

(Presented May 28, 1885.)

Three years ago, at the first meeting of this Society, I had the honor of reading a paper "On the Law of Facility of Error in the sum of n Independent Quantities, each accurate to the Nearest Unit,"[1] which paper was printed in the first volume of our Proceedings. I there made use of the approximate value, found by Laplace and confirmed by Cauchy, of the expression—

$$\frac{1}{\lfloor n}\left\{\left(x+\frac{n}{2}\right)^{n}-n\left(x+\frac{n}{2}-1\right)^{n}+\ldots+(-1)^{r}\frac{\lfloor n}{\lfloor n-r\,\lfloor r}\left(x+\frac{n}{2}-r\right)^{n}+\ldots+(-1)^{n}\left(x-\frac{n}{2}\right)^{n}\right\}$$

where n is any positive integer, and the series is to be continued only as long as the quantity raised to power n is positive.

Isaac Todhunter, in his "History of the Theory of Probabilities," says[2] on the Chapter in Laplace, in which the approximate value is given, "we may observe that this Chapter contains many important results, but it is to be regretted that the demonstrations are very imperfect. The memoir of Cauchy,[3] to which we have referred, is very laborious and difficult, so that this portion of the *Théorie des Probabilités* remains in an unsatisfactory state."

This remark led to the investigations that I now propose to lay before you, which (while they confirm the results of Laplace and Cauchy in the case which was quoted in my previous paper, and also, if we correct some *numerical* errors in Cauchy's results, in other similar cases) shew that a greater objection than that of being "very laborious and difficult" may be taken to Cauchy's proof, namely, that a large number of his intermediate results are erroneous in the particular cases in which he employs them. The results to which I refer are the values which he obtains for certain *extraordinary integrals*, to which attention will be drawn in the sequel.

Let us for brevity denote by $\varphi\,(x, m, n)$ the expression—

$$\text{“}\frac{1}{\lfloor m+n}\left\{\left(x+\frac{n}{2}\right)^{m+n}-n\left(x+\frac{n}{2}-1\right)^{m+n}_{\cdots}+(-1)^{r}\frac{\lfloor n}{\lfloor n-r\,\lfloor r}\left(x+\frac{n}{2}-r\right)^{m+n}_{\cdots}+(-1)^{n}\left(x-\frac{n}{2}\right)^{m+n}\right\}$$

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[1] In the paper as printed, the word "degree" was, by printers' error, substituted for "unit."

[2] History of the Theory of Probabilities, § 968, p. 526.

[3] The memoir of Cauchy is published in the Journal de l'École Polytechnique, 28e cahier.

the series to be continued only as long as the quantity raised to power $m+n$ is positive. n being a positive integer."

The method which Cauchy employs to obtain a definite integral to represent the value of what we here call $\varphi(x, m, n)$ fails when m is an integer or zero, as it involves the repeated integration with respect to a variable of an expression, in which the variable is raised to power $m+n-\lambda-1$ where λ is the greatest integer in $m+n$. He assumes, however, without comment, that his results will hold for integral values, but when m is zero or a positive integer, we shall find that this is not the case.

In all that follows we shall suppose m to be a positive integer, zero, or a negative integer numerically less than n.

If in the expression for $\varphi(x, m, n)$ we put n equal to zero, it reduces to zero when x is negative, and to $\frac{1}{\lfloor m} x^m$ when x is positive. We will represent the expression in this case by $\varphi(x, m)$.

If we differentiate $\varphi(x, m)$ with respect to x, we obtain $\varphi(x, m-1)$ (supposing m be not zero);

Conversely, if we integrate $\varphi(x, m)$ with respect to x between the limits 0 and x we obtain—

$$\int_0^x \varphi(x, m)\, dx = \varphi(x, m+1) - \varphi(0, m+1)$$
$$= \varphi(x, m+1) \qquad \text{(i)}$$

If in equation (i) m is equal to zero, there will be discontinuity in the value of $\varphi(x, m)$ at $x = 0$. We will proceed to consider this case further, and at the same time we will somewhat enlarge the meaning of $\varphi(x, 0)$.

Let, then, $\varphi(x, 0)$ represent a function which is zero when x is negative and unity when x is positive, and which has any finite value whatever when $x = 0$.

We have, then,—

$$\int_0^x \varphi(x, 0)\, dx = \int_c^x \varphi(x, 0)\, dx + \int_0^c \varphi(x, 0)\, dx$$

Let A be the greatest and —B the least value of $\varphi(x, 0)$. Then $\int_0^c \varphi(x, 0)\, dx$ must lie between A c and —B c, and remembering that $\varphi(x, 1)$ represents zero when x is negative and x when x is positive, we see that if we take c of the same sign with x, $\int_0^x \varphi(x, 0)\, dx$ must lie between $\varphi(x, 1) - \varphi(c, 1) + Ac$ and $\varphi(x, 1) - \varphi(c, 1) - Bc$. If now we diminish c without limit, $\varphi(c, 1)$, Ac and Bc all ultimately vanish, and we still have—

$$\int_0^x \varphi(x, 0)\, dx = \varphi(x, 1) \qquad \text{(ii)}$$

If instead of integrating $\varphi(x, m)$ between the limits 0 and x, we integrate between the limits $x - \frac{1}{2}$ and $x + \frac{1}{2}$, we find—

$$\int_{x-\frac{1}{2}}^{x+\frac{1}{2}} \varphi(x, m)\, dx = \int_0^{x+\frac{1}{2}} \varphi(x, m)\, dx - \int_0^{x-\frac{1}{2}} \varphi(x, m)\, dx$$
$$= \varphi(x+\tfrac{1}{2}, m+1) - \varphi(x-\tfrac{1}{2}, m+1) \qquad \text{(iii)}$$
$$\text{or} = \varphi(x, m, 1) \qquad \text{(iv.)}$$

Now, from the definitions of $\varphi(x, m, n)$ and $\varphi(x, m)$ we have—

$$\varphi(x, m, n) = \varphi\left(x + \frac{n}{2}, m+n\right) - n\,\varphi\left(x + \frac{n}{2} - 1, m+n\right) + \ldots\ldots$$

$$+ (-1)^r \frac{\lfloor n}{\lfloor n-r \lfloor r}\,\varphi\left(x + \frac{n}{2} - r, m+n\right) + \ldots + (-1)^n \varphi\left(x - \frac{n}{2}, m+n\right)$$

Hence by (iii.)—

$$\int_{x-\frac{1}{2}}^{x+\frac{1}{2}} \varphi(x. m, n)\,dx = \varphi\left(x + \frac{n+1}{2}, m+n+1\right) - \varphi\left(x + \frac{n-1}{2}, m+n+1\right)$$

$$-n\left\{\varphi\left(x + \frac{n+1}{2} - 1, m+n+1\right) - \varphi\left(x + \frac{n-1}{2} - 1, m+n+1\right)\right\} + \ldots\ldots$$

$$+ (-1)^r \frac{\lfloor n}{\lfloor r \lfloor n-r}\left\{\varphi\left(x + \frac{n+1}{2} - r, m+n+1\right) - \varphi\left(x + \frac{n-1}{2} - r, m+n+1\right)\right\} + \ldots$$

$$+ (-1)^n\left\{\varphi\left(x + \frac{n+1}{2} - n, m+n+1\right) - \varphi\left(x + \frac{n-1}{2} - n, m+n+1\right)\right\}$$

$$= \varphi\left(x + \frac{n+1}{2}, m+n+1\right) - (n+1)\,\varphi\left(x + \frac{n+1}{2} - 1, m+n+1\right) + \ldots\ldots$$

$$+ (-1)^r \frac{\lfloor n+1}{\lfloor n+1-r \lfloor r}\,\varphi\left(x + \frac{n+1}{2} - r, m+n+1\right) + \ldots\ldots$$

$$(-1)^{n+1}\varphi\left(x - \frac{n+1}{2}, m+n+1\right)$$

$$= \varphi(x, m, n+1) \qquad \text{(v)}$$

If, then, we obtain any function which is equal to $\varphi(x, 0)$, where $\varphi(x, 0)$ may have the more extended meaning last given to it, we can, by the aid of (ii) and (i), obtain a function which will be equal to $\varphi(x, m)$, and then by the aid of (iv) and (v) a function equal to $\varphi(x, m, n)$.

Now the expression—

$$\frac{1}{2\,l}\int_{-l}^{l}\varphi(v)\,dv + \frac{1}{l}\,\Sigma_1^\infty \int_{-l}^{l}\varphi(v)\cos\frac{n\,\pi\,(v-x)}{l}\,dv$$

where Σ represents summation with respect to n, is known to be equal to $\varphi(x)$, for all values of x between the limits $-\,l$ and l, except where any discontinuity occurs in $\varphi(x)$, and there the expression is still finite.

Hence, when x is between the limits $-\,l$ and l, we have—

$$\varphi(x, 0) = \frac{1}{2\,l}\int_0^l dv + \frac{1}{l}\,\Sigma_1^\infty \int_0^l \cos\frac{n\,\pi\,(v-x)}{l}\,dv$$

$$= \tfrac{1}{2} + \frac{1}{l}\,\Sigma_1^\infty \frac{l}{n\,\pi}\sin\frac{n\,\pi\,(l-x)}{l} + \frac{1}{l}\,\Sigma_1^\infty \frac{l}{n\,\pi}\sin\frac{n\,\pi\,x}{l}$$

$$= \tfrac{1}{2} + \Sigma_1^\infty \frac{2}{(2\,n-1)\,\pi}\sin\frac{(2\,n-1)\,\pi\,x}{l}$$

Let $\frac{(2n-1)\pi}{l} = \theta$, $\frac{2\pi}{l} = \Delta\theta$; then

$$\varphi(x, 0) = \tfrac{1}{2} + \frac{1}{\pi} \Sigma_{\frac{\pi}{l}}^{\infty} \frac{\sin x\theta}{\theta} \Delta\theta$$

If l be increased indefinitely, this reduces to

$$\varphi(x, 0) = \tfrac{1}{2} + \frac{1}{\pi} \int_0^{\infty} \frac{\sin x\theta}{\theta} d\theta \qquad \text{(vi)}$$

This result agrees with the value of $\int_0^{\infty} \frac{\sin x\theta}{\theta} d\theta$, given in Todhunter's Integral Calculus (second edition, p. 246).

Integrating (vi) with respect to x, m times between the limits 0 and x, we obtain by (i)—

$$\varphi(x, m) = \tfrac{1}{2} \frac{x^m}{\lfloor m} + \frac{1}{\pi} \int_0^{\infty} \frac{\cos\left(x\theta - \frac{m+1}{2}\pi\right) + \frac{x^{m-1}}{\lfloor m-1} \theta^{m-1} - \frac{x^{m-3}}{\lfloor m-3} \theta^{m-3} + \text{\&c.}}{\theta^{m+1}} d\theta \qquad \text{(vii)}$$

and integrating (vii) with respect to x, n times between the limits $x - \frac{1}{2}$ and $x + \frac{1}{2}$, we obtain by (iv) and (v)—

$$\varphi(x, m, n) = \tfrac{1}{2} \frac{\Delta^n (x - \frac{n}{2})^{m+n}}{\lfloor m+n}$$

$$+ \frac{1}{\pi} \int_0^{\infty} \frac{\cos\left(x\theta - \frac{m+1}{2}\pi\right) \left(\frac{\sin\frac{1}{2}\theta}{\frac{1}{2}\theta}\right)^n + \frac{\Delta^n (x - \frac{n}{2})^{m+n-1}}{\lfloor m+n-1} \theta^{m-1} - \text{\&c.}}{\theta^{m+1}} d\theta \qquad \text{(viii)}$$

By differentiating $2m$ times with respect to x, we find—

$$\varphi(x, -m, n) = \frac{1}{\pi} \int_0^{\infty} \frac{\cos\left(x\theta + \frac{m-1}{2}\pi\right) \left(\frac{\sin\frac{1}{2}\theta}{\frac{1}{2}\theta}\right)^n}{\theta^{-m+1}} d\theta \qquad \text{(ix)}$$

The result (ix) agrees with those of Cauchy and Laplace, (vii) and (viii) differ from Cauchy's in containing the terms $\frac{1}{2} \cdot \frac{x^m}{\lfloor m}$ and $\frac{1}{2} \frac{\Delta^n (x - \frac{1}{2}n)^{m+n}}{\lfloor m+n}$ respectively. Equation (ix), it will be noticed, is only a particular case of equation (viii).

Cauchy designates the integral

$$\int_0^{x_1} \frac{P - X}{x^{\alpha+1}} dx$$

where P is any function of the variable x, and

$$X = c + c_1 x + c_2 x^2 + \ldots\ldots + c_\lambda x^\lambda$$

the first terms of the development of P in ascending powers of x, λ being the greatest whole number not greater than α, an extraordinary integral, and represents it by

$$\int' \frac{P}{x^{\alpha+1}} dx \qquad \begin{cases} x = 0 \\ x = x_1 \end{cases}$$

Adopting this notation, but omitting specific mention in each case of the limits of integration of the extraordinary integrals, which will, throughout this paper, be between the values zero and infinity of the variables, equation (viii) becomes

$$\varphi(x, m, n) = \tfrac{1}{2}\,\frac{\Delta^n \left(x - \frac{n}{2}\right)^{m+n}}{\lfloor m+n} + \frac{2^n}{\pi}\int' \frac{\cos\left(x\,\theta - \frac{m+1}{2}\pi\right)\left(\sin\frac{\theta}{2}\right)^n}{\theta^{m+n+1}}\,d\theta \qquad \text{(x)}$$

for it is obvious from the way in which the terms

$$\frac{\Delta^n \left(x - \frac{n}{2}\right)^{m+n-1}}{\lfloor m+n-1} \cdot \theta^{m-1} \cdot \quad - \ldots \text{\&c.}$$

were introduced, that they are the earlier terms in the expansion, in ascending powers of x, of

$$\cos\left(x\,\theta - \frac{m+1}{2}\pi\right) \cdot \left\{\frac{\sin\frac{\theta}{2}}{\frac{\theta}{2}}\right\}^n$$

It now remains to deduce from equation (x) the approximate value of $\varphi\,(x, m, n)$, when n is large and m a small integer. We shall suppose in what follows that x is of the order $\sqrt{n}$, and we will put

$$x = \tfrac{1}{2}\,r\,\sqrt{n}$$

Substituting this value of x in the integral occurring in (x) and writing $2\,\theta$ for θ we get

$$\varphi(x, m, n) = \tfrac{1}{2}\,\frac{\Delta^n \left(x - \frac{n}{2}\right)^{m+n}}{\lfloor m+n} + \frac{1}{2^m\pi}\int' \frac{\cos\left(r\sqrt{n}\,\theta - \frac{m+1}{2}\pi\right)\sin^n\theta}{\theta^{m+n+1}}\,d\theta$$

But $\sin^n\theta = \theta^n\,\varepsilon^{-\frac{n}{6}\theta^2}\left(1 - \frac{n\,\theta^4}{180} - \text{\&c.}\right)$ so that

$$\varphi(x, m, n) = \tfrac{1}{2}\,\frac{\Delta^n \left(x - \frac{n}{2}\right)^{m+n}}{\lfloor m+n} + \frac{1}{2^m\pi}\int' \frac{\cos\left(r\sqrt{n}\,\theta - \frac{m+1}{2}\pi\right) . \,\varepsilon^{-\frac{n\,\theta^2}{6}}}{\theta^{m+1}}\left(1 - \frac{n\,\theta^4}{180} - \text{\&c.}\right)d\theta$$

If in this last equation we change θ into $\frac{\theta}{\sqrt{n}}$, we obtain

$$\varphi(x, m, n) = \tfrac{1}{2}\,\frac{\Delta^n \left(x - \frac{n}{2}\right)^{m+n}}{\lfloor m+n} + \frac{n^{\frac{m}{2}}}{2^m\pi}\left\{\int' \frac{\cos\left(r\,\theta - \frac{m+1}{2}\pi\right)}{\theta^{m+1}}\,\varepsilon^{-\frac{\theta^2}{6}}\,d\theta\right.$$

$$\left. - \frac{1}{180n}\int' \frac{\cos\left(r\,\theta - \frac{m-3}{2}\pi\right)}{\theta^{m-3}}\,\varepsilon^{-\frac{\theta^2}{6}}\,d\theta - \text{\&c.}\right\} \qquad \text{(xi)}$$

The series of extraordinary integrals in (xi) proceeds in inverse powers of n, and

will be rapidly convergent when n is large. The value of $\varphi\ (x,\ m,\ n)$ may accordingly be found approximately from (xi), for small values of m, if we calculate the values of—

$$\int' \frac{\cos\left(r\,\theta - \frac{m+1}{2}\pi\right)}{\theta^{m+1}}\ \varepsilon^{-\frac{\theta^2}{6}} d\theta$$

for a few values of m.

In order to obtain the value of this integral, let us first take the well-known integral

$$\int_0^{\infty} \varepsilon^{-y^2} dy = \frac{\sqrt{\pi}}{2}$$

For y write $\sqrt{x}\ .\ \theta$ we find that

$$\int_0^{\infty} \varepsilon^{-x\,\theta^2} d\theta = \tfrac{1}{2}\sqrt{\frac{\pi}{x}}$$

Integrating both sides of this equation with respect to x, p times between the limits 0 and x we find

$$\int' \frac{\varepsilon^{-x\,\theta^2}}{\theta^{2p}}\ d\theta = \frac{(-2)^p}{1\,.\,3\ldots\ldots(2\,p-1)}\ \tfrac{1}{2}\,.\,x^p\sqrt{\frac{\pi}{x}}$$

or, making $x = \frac{1}{6}$

$$\int' \frac{\varepsilon^{-\frac{\theta^2}{6}}}{\theta^{2p}}\ d\theta = (-\tfrac{1}{3})^p\ \frac{1}{1\,.\,3\ldots\ldots(2\,p-1)}\sqrt{\frac{3\pi}{2}} \qquad \text{(xii)}$$

Again take the well-known integral

$$\int_0^{\infty} \varepsilon^{-a^2\,\theta^2} \cos 2\,r\theta\,d\theta = \frac{\sqrt{\pi}}{2a}\ \varepsilon^{-\frac{r^2}{a^2}}$$

and in it write $\frac{\theta}{2}$ for θ, and put $a^2 = \frac{2}{3}$ we obtain

$$\int_0^{\infty} \varepsilon^{-\frac{\theta^2}{6}} \cos r\,\theta\,.\,d\theta = \sqrt{\frac{3\pi}{2}}\,.\,\varepsilon^{-\frac{3}{2}r^2}$$

Integrate with respect to r between the limits 0 and r we get

$$\int' \varepsilon^{-\frac{\theta^2}{6}}\ \frac{\cos\left(r\,\theta - \frac{\pi}{2}\right)}{\theta}\,.\,d\theta = \sqrt{\frac{3\pi}{2}}\int_0^{r} \varepsilon^{-\frac{3}{2}r^2}\,dr \qquad \text{(xiii)}$$

Integrate again with respect to r between the limits 0 and r we have

$$\int' \varepsilon^{-\frac{\theta^2}{6}}\ \frac{\cos\left(r\,\theta - 2\,\frac{\pi}{2}\right)}{\theta^2}\,d\theta + \int' \varepsilon^{-\frac{\theta^2}{6}}\,\frac{d\theta}{\theta^2} = \sqrt{\frac{3\pi}{2}}\left\{ r\int_0^{r} \varepsilon^{-\frac{3}{2}r^2}\,dr + \tfrac{1}{3}\,\varepsilon^{-\frac{3}{2}r^2} - \tfrac{1}{3}\right\}$$

whence by (xii)

$$\int' \varepsilon^{-\frac{\theta^2}{6}} \frac{\cos\left(r\,\theta - 2\,\frac{\pi}{2}\right)}{\theta^2}\,d\theta = \sqrt{\frac{3\pi}{2}}\left\{ r\int_0^r \varepsilon^{-\frac{3}{2}r^2}\,dr + \tfrac{1}{3}\,\varepsilon^{-\frac{3}{2}r^2} \right\} \qquad \text{(xiv)}$$

We now see that

$$\int' \varepsilon^{-\frac{\theta^2}{6}} \frac{\cos\left(r\,\theta - 2\,\frac{\pi}{2}\right)}{\theta^2}\,d\theta = r\int' \varepsilon^{-\frac{\theta^2}{6}} \frac{\cos\left(r\,\theta - \frac{\pi}{2}\right)}{\theta}\,d\theta + \tfrac{1}{3}\int' \varepsilon^{-\frac{\theta^2}{6}} \cos r\theta\,.\,d\theta$$

Let us assume that for any given positive integral value of p

$$p\int' \varepsilon^{-\frac{\theta^2}{6}} \frac{\cos\left\{r\,\theta - (p+1)\frac{\pi}{2}\right\}}{\theta^{p+1}}\,d\theta = r\int' \varepsilon^{-\frac{\theta^2}{6}} \frac{\cos\left(r\,\theta - p\,\frac{\pi}{2}\right)}{\theta^{p}}\,d\theta + \tfrac{1}{3}\int' \varepsilon^{-\frac{\theta^2}{6}} \frac{\cos\left(r\,\theta - \frac{p-1}{2}\,.\,\pi\right)}{\theta^{p-1}}\,d\theta \qquad \text{(xv)}$$

we will show that this equation will also hold when $p + 1$ is written for p. For if we integrate both sides of (xv) with respect to r we get

$$p\int' \varepsilon^{-\frac{\theta^2}{6}} \frac{\cos\left(r\,\theta - \frac{p+2}{2}\,.\,\pi\right)}{\theta^{p+2}}\,d\theta = r\int' \varepsilon^{-\frac{\theta^2}{6}} \frac{\cos\left(r\,\theta - \frac{p+1}{2}\,\pi\right)}{\theta^{p+1}}\,d\theta$$

$$-\int' \varepsilon^{-\frac{\theta^2}{6}} \frac{\cos\left(r\,\theta - \frac{p+2}{2}\right)}{\theta^{p+2}}\,d\theta + \tfrac{1}{3}\int' \varepsilon^{-\frac{\theta^2}{6}} \frac{\cos\left(r\,\theta - \frac{p}{2}\,\pi\right)}{\theta^{p}}\,d\theta + C$$

or

$$(p+1)\int' \varepsilon^{-\frac{\theta^2}{6}} \frac{\cos\left(r\,\theta - \frac{p+2}{2}\,\pi\right)}{\theta^{p+2}}\,d\theta = r\int' \varepsilon^{-\frac{\theta^2}{6}} \frac{\cos\left(r\,\theta - \frac{p+1}{2}\,\pi\right)}{\theta^{p+1}}\,d\theta$$

$$+\tfrac{1}{3}\int' \varepsilon^{-\frac{\theta^2}{6}} \frac{\cos\left(r\,\theta - \frac{p}{2}\,\pi\right)}{\theta^{p}}\,d\theta + C \qquad \text{(xvi)}$$

This equation is the same as (xv), with $p + 1$ written for p, except that it contains the constant C. If, then, $C = 0$ equation (xv) will hold with $p + 1$, written for p.

In (xvi) put $r = 0$. Then, if p is odd, all the terms vanish except C, and the equation reduces to

$$C = 0$$

If p is even, let it equal $2q$, and we shall have

$$(-1)^{q+1}\,(2q+1)\int' \frac{\varepsilon^{-\frac{\theta^2}{6}}}{\theta^{2q+2}}\,d\theta = (-1)^{q}\,.\,\tfrac{1}{3}\int' \frac{\varepsilon^{-\frac{\theta}{6}}}{\theta^{2q}}\,.\,d\theta + C$$

or by (xii)

$$\left(\tfrac{1}{3}\right)^{q+1}\,.\,\frac{2\,q+1}{1.3\ldots(2\,q+1)}\,.\,\sqrt{\frac{3\pi}{2}} = \left(\tfrac{1}{3}\right)^{q+1}\,.\,\frac{1}{1.3.\,.(2\,q-1)}\,\sqrt{\frac{3\,\pi}{2}} + C$$

whence in this case also $C = 0$, and, consequently, equation (xv) will hold with $p + 1$ written for p, whatever integer p may be. But we have already seen that the equation is true when $p = 1$; it is, therefore, true for $p = 2$, or $p = 3$, &c.

If then we write I_m for $\int^r \frac{\varepsilon^{-\frac{\theta^2}{6}} \cos (r\,\theta - m\,\frac{\pi}{2})}{\theta^m} d\theta$ we have by (xiii) and (xiv)

$$\mathrm{I}_1 = \sqrt{\frac{3\,\pi}{2}} \int_0^r \varepsilon^{-\frac{3}{2}r^2} dr$$

$$\mathrm{I}_2 = \sqrt{\frac{3\,\pi}{2}} \left\{ r \int_0^r \varepsilon^{-\frac{3}{2}r^2} dr + \tfrac{1}{3}\,\varepsilon^{-\frac{3}{2}r^2} \right\}$$

whence by (xv)

$$\mathrm{I}_3 = \sqrt{\frac{3\,\pi}{2}} \left\{ \frac{3\,r^2 + 1}{6} \int_0^r \varepsilon^{-\frac{3}{2}r^2} dr + \frac{r}{2\,.\,3}\,\varepsilon^{-\frac{3}{2}r^2} \right\}$$

$$\mathrm{I}_4 = \sqrt{\frac{3\,\pi}{2}} \left\{ \frac{r^3 + r}{6} \int_0^r \varepsilon^{-\frac{3}{2}r^2} dr + \frac{3\,r^2 + 2}{54}\,\varepsilon^{-\frac{3}{2}r^2} \right\}$$

$$\mathrm{I}_5 = \sqrt{\frac{3\,\pi}{2}} \left\{ \frac{3\,r^4 + 6\,r^2 + 1}{72} \int_0^r \varepsilon^{-\frac{3}{2}r^2} dr + \frac{r\,(3\,r^2 + 5)}{216}\,\varepsilon^{-\frac{3}{2}r^2} \right\}$$

These results do not agree with Cauchy's. His M_{1+k}* should be equal to $\frac{1}{\pi}\,.\,6^{\frac{1}{2}k}\,.\,\mathrm{I}_{1+k}$ with $-r$ written for r, but it differs from it, in every case, by terms which do not contain either $\varepsilon^{-\frac{3}{2}r^2}$ or $\int_0^r \varepsilon^{-\frac{3}{2}r^2} dr$

Again, from the equation

$$\mathrm{I}_0 = \int_0^\infty \varepsilon^{-\frac{\theta^2}{6}} \cos r\,\theta\,d\theta = \sqrt{\frac{3\,\pi}{2}}\,.\,\varepsilon^{-\frac{3}{2}r^2}$$

we may, by successive differentiations with respect to r, obtain

$$\mathrm{I}_{-1} = -\sqrt{\frac{3\,\pi}{2}}\,.\,3\,r\,.\,\varepsilon^{-\frac{3}{2}r^2}$$

$$\mathrm{I}_{-2} = 3\sqrt{\frac{3\,\pi}{2}}\,.\,(3\,r^2 - 1)\,.\,\varepsilon^{-\frac{3}{2}r^2}$$

$$\mathrm{I}_{-3} = -\,27\sqrt{\frac{3\,\pi}{2}}\,.\,r\,(r^2 - 1)\,\varepsilon^{-\frac{3}{2}r^2}$$

$$\mathrm{I}_{-4} = 27\sqrt{\frac{3\,\pi}{2}}\,(3\,r^4 - 6\,r^2 + 1)\,\varepsilon^{-\frac{3}{2}r^2}$$

* See Journal de l'École Polytechnique, 28e Cahier, p. 238.

$$I_{-5} = -81 \sqrt{\frac{3\pi}{2}}\, r\,(3r^4 - 10r^2 + 5)\,\varepsilon^{-\frac{3}{2}r^2}$$

These values agree with Cauchy's.

Now it is easily shewn, by repeated integrations of $\frac{1}{2} \cdot \frac{x^4}{\lfloor 4}$ between the limits $x - \frac{1}{2}$ and $x + \frac{1}{2}$, that

$$\tfrac{1}{2}\, \Delta^n \frac{(x - \frac{n}{2})^{n+4}}{\lfloor n+4} = \frac{x^4}{48} + \frac{n \cdot x^2}{96} + \frac{n^2}{16 \cdot 144} - \frac{n}{16} \cdot \frac{1}{360}$$

$$= (\tfrac{1}{2})^4 \left\{ \frac{3r^4 + 6r^2 + 1}{144} n^2 - \frac{n}{360} \right\} \quad \text{since } x = \frac{r\sqrt{n}}{2}$$

Differentiating with respect to x or $\frac{r\sqrt{n}}{2}$ we get

$$\tfrac{1}{2}\, \Delta^n \frac{(x - \frac{n}{2})^{n+3}}{\lfloor n+3} = (\tfrac{1}{2})^3 \cdot \frac{r\,(r^2+1)}{12}\, n^{\frac{3}{2}}$$

So $$\tfrac{1}{2}\, \Delta^n \frac{(x - \frac{n}{2})^{n+2}}{\lfloor n+2} = (\tfrac{1}{2})^2\, \frac{3r^2+1}{12}\, n$$

$$\tfrac{1}{2}\, \Delta^n \frac{(x - \frac{n}{2})^{n+1}}{\lfloor n+1} = \tfrac{1}{2} \cdot \frac{r}{2} \cdot n^{\frac{1}{2}}$$

$$\tfrac{1}{2}\, \Delta^n \frac{(x - \frac{n}{2})^{n}}{\lfloor n} = \tfrac{1}{2}$$

If we substitute these values, and those of I_{m+1}, &c., in equation (xi), which may be written

$$\varphi\,(x, m, n) = \tfrac{1}{2} \cdot \frac{\Delta^n\, (x - \frac{n}{2})^{m+n}}{\lfloor m+n} + \frac{n^{\frac{m}{2}}}{2^m \pi} \left\{ I_{m+1} - \frac{1}{180n} \cdot I_{m-3} - \&c. \right\}$$

we obtain the following approximate values for $\varphi\,(\frac{r}{2}\sqrt{n}, m, n)$ that is for

$$\frac{1}{2^{n+m}} \cdot \frac{1}{\lfloor m+n} \left\{ (r\, n^{\frac{1}{2}} + n)^{n+m} - \frac{n}{1} \cdot (r n^{\frac{1}{2}} + n - 2)^{n+m} + \frac{n\,(n-1)}{1 \cdot 2}\, (r n^{\frac{1}{2}} + n - 4)^{n+m} - \ldots \right\}$$

the series to be continued only as long as the quantity raised to power $n + m$ is positive,

when $m = 4$

$$\varphi\left(\frac{r}{2}\sqrt{n}, m, n\right) = \frac{n^2}{2^4}\left\{\frac{3r^4+6r^2+1}{144}\left(1+2\sqrt{\frac{3}{2\pi}}\int_0^r \varepsilon^{-\frac{3}{2}r^2}dr\right)\right.$$

$$\left. + \frac{r(3r^2+5)}{216\,n}\sqrt{\frac{3}{2\pi}}\,\varepsilon^{-\frac{3}{2}r^2} - \frac{1}{360.n}\left(1+2\sqrt{\frac{3}{2\pi}}\int_0^r \varepsilon^{-\frac{3}{2}r^2}dr\right) - \dots\right\}$$

when $m = 3$

$$\varphi\left(\frac{r}{2}\sqrt{n}, m, n\right) = \frac{n^{\frac{3}{2}}}{2^3}\left\{\frac{r(r^2+1)}{12}\left(1+2\sqrt{\frac{3}{2\pi}}\int_0^r \varepsilon^{-\frac{3}{2}r^2}dr\right)\right.$$

$$\left. + \frac{3r^2+2}{54}\sqrt{\frac{3}{2\pi}}\,\varepsilon^{-\frac{3}{2}r^2} - \frac{1}{180.n}\sqrt{\frac{3}{2\pi}}\,\varepsilon^{-\frac{3}{2}r^2} - \dots\right\}$$

when $m = 2$

$$\varphi\left(\frac{r}{2}\sqrt{n}, m, n\right) = \frac{n}{2^2}\left\{\frac{3r^2+1}{12}\left(1+2\sqrt{\frac{3}{2\pi}}\int_0^r \varepsilon^{-\frac{3}{2}r^2}dr\right)\right.$$

$$\left. + \frac{r}{6}\sqrt{\frac{3}{2\pi}}\,.\,\varepsilon^{-\frac{3}{2}r} + \frac{1}{60.n}\sqrt{\frac{3}{2\pi}}\,.\,r\,.\,\varepsilon^{-\frac{3}{2}r^2} - \dots\right\}$$

when $m = 1$

$$\varphi\left(\frac{r}{2}\sqrt{n}, m, n\right) = \frac{n^{\frac{1}{2}}}{2}\left\{\frac{r}{2}\left(1+2\sqrt{\frac{3}{2\pi}}\int_0^r \varepsilon^{-\frac{3}{2}r^2}dr\right) + \sqrt{\frac{3}{2\pi}}\,\varepsilon^{-\frac{3}{2}r}\left(\tfrac{1}{3} - \frac{3r^2-1}{60.n}\right) - \dots\right\}$$

when $m = 0$

$$\varphi\left(\frac{r}{2}\sqrt{n}, m, n\right) = \tfrac{1}{2} + \sqrt{\frac{3}{2\pi}}\left\{\int_0^r \varepsilon^{-\frac{3}{2}r^2}dr - \frac{3}{20n}r(r^2-1)\,\varepsilon^{-\frac{3}{2}r^2} - \dots\right\}$$

when $m = -1$

$$\varphi\left(\frac{r}{2}\sqrt{n}, m, n\right) = \sqrt{\frac{3}{2n\pi}}\left\{\varepsilon^{-\frac{3}{2}r^2} - \frac{3}{20n}(3r^4-6r^2+1)\,\varepsilon^{-\frac{3}{2}r^2} - \dots\right\}$$

when $m = -2$

$$\varphi\left(\frac{r}{2}\sqrt{n}, m, n\right) = -\frac{3r}{n}\varepsilon^{-\frac{3}{2}r^2}\sqrt{\frac{3}{2\pi}}\left\{1 - \frac{3}{20n}(3r^4-10r^2+5) - \dots\right\}$$

The values here found for $\varphi\left(\frac{r}{2}\sqrt{n}, m, n\right)$ when $m = 1, 0, -1$, and -2, agree with those found by Laplace and Cauchy. Laplace did not determine the value when $m = 2$, 3 or 4, and there are numerical errors in the results given by Cauchy in these three cases; but if these errors be corrected, his results are brought into agreement with those here found.

IX.—*The Longitude of the McGill College Observatory.*

By PROFESSOR W. A. ROGERS, Harvard College Observatory, *and* PROFESSOR C. H. MCLEOD, McGill College Observatory.

(Communicated by Dr. Johnson, May 28, 1885.)

CONTENTS.

PART I.

In March, 1857, Lieut. Ashe, R.N., by the telegraphic transmission of clock signals, determined the difference of longitude between a point in Viger Garden, Montreal, and his astronomical station at Quebec, and assigned to the former position the longitude $4_h\ 54^m\ 11^s.85$ W. The pier of the transit instrument at the McGill College Observatory is $5^s.6$ west of the station in Viger Garden, and hence the longitude of the Observatory is made $4^h\ 54^m\ 17^s\ 45$. The accepted value of the longitude of the station at Quebec rests upon a determination through the Harvard College Observatory, wherein no attempt was made to eliminate the effect of the personal equation of the observers. The difference between Montreal and Quebec was also determined without correction for personal equation or interchange of observers. Owing to these circumstances some doubt has always existed as to the accuracy of the result obtained by Lieut. Ashe. There is to be added to the values above given, $0^s.29$, the reduction of the old value of the Cambridge station to that obtained through the Atlantic cables. The corrected value of the longitude of the Observatory as obtained through Quebec is, therefore, $4^h\ 54^m\ 17^s.74$.

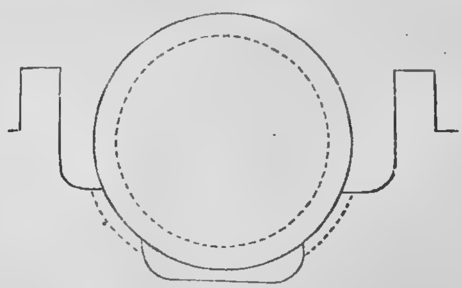
In the summer of 1881 an unoccupied station in connection with the United States Coast and Geodetic Survey was established on Mount Royal and triangulated to by the late General Cutts from the stations Dannemora, in New York State, and Bellevue, in Vermont. The resulting longitude of the Mount Royal station is $73^\circ\ 35'\ 25''.20$. In communicating this result Mr. Schott, assistant in charge of the Computing Division of the Coast and Geodetic Survey remarks that there is no check upon it. In September, 1882, the station on Mount Royal was connected with the Observatory by a trigonometrical survey and a difference in longitude of $2''.81$ obtained. Applying this difference, we have as the longitude of the Observatory from connection with the Coast and Geodetic Survey,

the value $4^h\ 54^m\ 18^s.87$, which differs from the determination through Quebec by $1^s.13$. This discrepancy, notwithstanding the acknowledged imperfection of the old determination, was unexpectedly large and pointed to the necessity of a new determination by direct connection with Cambridge. Professor Pickering very kindly granted the use of such of the apparatus of the Harvard College Observatory as might be necessary in the prosecution of the work, and at his request Professor W. A. Rogers undertook the determination with me. One half the expense of the work was borne by the Harvard College Observatory.

The Station at Montreal was that occupied by the transit instrument of the McGill College Observatory. It is situated in rear of the main college building and twenty feet to the west of the meridian passing through the centre of the Blackman telescope pier.

Instruments at Montreal.

The transit instrument, made by Jones & Son, London, has been refitted with bearings, pivots and micrometer by Mr. G. F. Ballou, of Boston, under the superintendence of Professor Rogers. The focal length is 43 in., and clear aperture 3·25 in. The power of the diagonal eyepiece used is 84. The object-glass is believed to be by Dollond. The pivots are of steel shrunk on the original gun-metal. The pivot bearings are of phosphor-bronze and are in the form of segments of a cylinder of the same diameter as the pivots. The diagram exhibits a section of the pivots and bearings to actual size.



A series of level tests made in the months of April, May and June, 1884, show that the pivots are truly cylindrical in form, but the evidence thus obtained is not quite so conclusive as to their equality. On the opposite page are given the results of these observations, arranged according to the temperature of the air at the time of the test. Each set is obtained from the mean of six level readings.

The arithmetical mean of the whole 87 sets gives — $0^s.0017$, and the mean temperature is 66°. These results seem to show that this correction is a function of the temperature, and from the construction of the pivots it is not unreasonable to suppose that such is the case. One pivot is hollow and the other solid. Assuming that the rate of expansion of the solid pivot is that due to gun metal, and that the rate of the hollow end is that due to steel, the change in the correction for inequality of pivots, per degree Fah., would be $0^s.0013$. Neglecting the observations on April 21st, which do not accord well with the remainder of the series, this correction, as obtained by observation is,

Date.	No. of Sets. L. W.	No. of Sets. L. E.	Temp. of Air.	Correction (L. W.)
1884.			°	s.
April 21......	4	3	36	— ·010
May 28......	3	2	50	— ·017
April 23......	2	3	52[1]	— ·017
June 14......	3	2	60	— ·007
May 22......	2	1	63[1]	— ·007
May 2......	3	3	64	— ·010
May 23......	3	3	66[1]	— ·005
May 21......	3	3	67	— ·001
June 11......	4	3	70	·000
May 26......	2	2	72	— ·004
June 19......	2	1	73	— ·004
May 19......	5	5	74	+ ·006
June 16......	4	3	78	+ ·008
June 18......	3	2	80	+ ·008
June 17......	4	4	81	+ ·015

0.0010. If there is really the change in the diameter of the pivots which the observations seem to show, the temperature which corresponds to zero correction is 70°. The time observations in this longitude determination were made at temperatures ranging between 60° and 74°, and no pivot correction has been applied.

The distance between the pivot bearings is 27 inches. There is no clamp, the setting being done by touch. There are two small setting circles at the eye end.

The reticule is ruled on glass and consists of five groups of five lines each, with the middle group subdivided half-way up the field so as to give a group of thirteen lines. The outside groups are intended only for personal equation work and the central group of thirteen lines for polar star observations. The equatorial distances between the means of each of the three central groups and the mean of all the wires in those groups were determined from fifty-four complete transits of stars between 30° south and 60° north, with the result $15^s.70$, zero, and $15^s.70$. An independent determination of the distances between adjacent lines was also made from twenty-seven polar stars, which proved that these also are essentially equal and have a value $2^s.62$. As the space between the groups was designed to be twice that between the lines, the distances between the lines as deduced from the group distances, given above, is $2^s.617$, or practically the same as by the direct determination. The reticule was ruled by Prof. Rogers, and is mounted on a horizontal micrometer slide. The value of one revolution of the micrometer screw is $6^s.3$.

The Striding Level is by Messrs. Fauth & Co., Washington. It is protected from rapid changes of temperature by an outside glass tube. The scale value of this level, as deter-

[1] The temperature of the air on April 22nd, May 22nd and 23rd, is uncertain, but was probably within 2° of what is given. The greatest deviation of any pair of level readings from the mean of the set was $0^s.006$, and the mean deviation was $0^s.0025$.

mined immediately after leaving the hands of the maker in April, 1883, was $0^s.146$. In May, 1884, a redetermination gave a value $0^s.160$, showing a change in the form of the glass. As the value of the scale still remained constant at all points, the accuracy of the instrument does not seem to have been impaired. The original scale value was used in the reduction of these observations.

The Time-piece was the Blackman mean-time clock, by Howard. It was provided with a seconds break-circuit wheel and a minute contact maker, by means of which the 60th second was omitted.

The Chronograph used in the first half of the work was one of the tape form, by Messrs. Cooke & Sons, York, England, but owing to the very great inconvenience experienced in its use, a cylinder chronograph which, through the courtesy of Admiral Shufeldt, we were fortunately enabled to obtain on loan from the United States Naval Observatory, was substituted for it in the latter half of the work. The tape chronograph had a clock pen and an observing pen; the latter was also used to record the Cambridge clock signals. In the cylinder instrument there was but one pen. The observing key which I used in the time observations at Montreal was arranged to make circuit. Professor Rogers afterwards used the same key converted to break circuit. In order to determine how the use of a make-circuit would affect my personal equation, I placed this key, arranged both to make and break, in the circuit of the chronograph, which ran at about one inch per second, and by mechanically adding a large number of the small intervals between the make and the break, obtained an average value somewhat less than $0^s.01$ In exchanging clock signals, the Montreal clock beats were, for the first part of the work, sent out directly by the break-circuit apparatus in the clock. In the latter part of the work, *i.e.*, on the nights on which Professor Rogers observed at Montreal, the clock signals were sent out through the chronograph, the end of the armature arm opposite to the pen having been arranged to repeat the clock breaks. The difference between the means of the transmission times on the first three nights, and on the last three nights, is probably due to the change of chronographs at Montreal. The Cambridge clock signals were, in all cases, received through a relay in the main telegraph line.

For a description of the instruments used at the Harvard College Observatory reference is made to Professor Rogers' report. The Cambridge time signals were transmitted directly to Montreal by the clock Frodsham 1327, and the Montreal signals were received through a relay in the main telegraph line.

Telegraphic Arrangements.

At Montreal, the main line was brought as a loop through the Observatory and grounded at the Great North Western Telegraph office. At Boston, the main line from Montreal was connected, without a repeater, with the Cambridge line. The connection between the two stations was therefore direct. Our very best thanks are due to Mr. Angus Grant, Superintendent of the Montreal Division of the Great North Western Telegraph Company, who personally performed the duties of telegraph operator at the Montreal station and also provided for the free use of the lines under his control. Our thanks are also due to the officials of the Western Union Telegraph Company, at Boston, for the free use of their lines. The telegraphic arrangements at Cambridge were under the care of Mr.

J. Rayner Edmands, assistant in charge of time in the Harvard College Observatory, and at Montreal, under the supervision of Professor G. H. Chandler.

Plan of the Work.

The scheme of work was drawn up by Professor Rogers. It provided for two series of observations and clock exchanges of three nights each, with an interchange of stations by the observers, and for personal equation observations on two nights at both stations.

Weather telegrams were exchanged on each evening during the continuance of the campaign. When there was suitable weather at both stations, the programme of operations was as follows:—(1) Examination of chronograph and chronograph circuits. (2) Determination of the collimation. (3) Adjustment of level of the axis of transit, when necessary. (4) Star observations beginning at $7^h\ 30^m$ p.m. A complete set of observations in reversed positions of the instrument to be made. (5) Exchange of clock-signals, beginning at ten o'clock Montreal time; Montreal first sending signals for twelve minutes and twenty seconds, beginning at a fiftieth second, and Cambridge receiving for the first two minutes with the Cambridge clock out of the chronograph circuit and for the remaining ten minutes with the clock in circuit; the Montreal observer to note the times of beginning and ending of his outgoing signals. This being completed, the Cambridge clock signals were sent to Montreal and there recorded on the chronograph in a similar manner. (6) Star observations—a second series to be obtained in each of the reversed positions of the instrument, as before the clock exchange. (7) Determination of the collimation.

By a complete set of star observations for time determination, in one position of the instrument, is to be understood: two subpolar stars, two stars north of $+ 65°$ declination, six stars between $+ 20°$ and $+ 65°$, two stars near the equator and two stars south of $— 10°$. A set of observations not to be considered available for longitude unless it contains at least two polar stars, two south stars, and four other stars, all fully observed. The level error to be determined at least every half hour, and more frequently when the intervals between observations permit.

Observing began at both stations, and the first clock exchange was made on June 2nd, 1883. Exchanges and time determinations were also made on June 4th and 5th. Professor Rogers than came to Montreal and observed with me for personal equation on two nights. The second series of observations and clock exchanges were successfully made on June 20th, 21st and 23rd, Professor Rogers observing at Montreal while I observed at Cambridge. On the night of June 23rd, after the exchange of clock signals, a number of observational signals of star transits were also exchanged. Five stars were observed at Cambridge and their transit recorded on both the Cambridge and Montreal chronographs. Owing to some difficulty in the arrangement of the local circuits, the observations of these stars at Montreal were only received on the Montreal chronograph. Later in the night, three stars were observed at Montreal and recorded on both chronographs. The observations for personal equation at Cambridge were made on June 28th and 30th.

It was found impossible to obtain two complete sets of observations before the time fixed for the clock exchange, and after the second night of the campaign, the instrument

was reversed only at the time of exchange; a complete set in one position being obtained before the clock exchange, and in the other position after the exchange of signals had been made.

Stars and Star Places.

The apparent right ascensions of the stars observed were taken from the *Berliner Astronomisches Jahrbuch für* 1883. The corrections given by Professor Rogers in his report were applied to the stars there named.

Personal Equation.

The same selection of stars was made in these observations as in the time observations, and each star was observed by both observers on such of the reticule groups as to give arithmetical means corresponding to the mean wire. To obviate any error which might arise from unequal spacing of the lines, we exchanged reticule groups in observing similarly situated stars. The results of these observations are given by Professor Rogers, and after arranging them according to declination, he remarks that "there is a slight diminution of the value of the equation (R — M) cos δ corresponding to an increase in the declination of the star observed." I have found that on the average of the work at both stations the observations at different declinations are made to accord fairly well when they are reduced to (R — M) cos $^{\frac{3}{4}}\delta$. This is represented in the following table:—

Cambridge.			Montreal.			Means at both Stations.
Mean δ of Group.	No. of Stars in Group.	(R — M) cos $^{\frac{3}{4}}\delta$	Mean δ of Group.	No. of Stars in Group.	(R — M) cos $^{\frac{3}{4}}\delta$	
°		s.	°		s.	s.
— 15·8	11	·163	— 14·7	12	·121	·142
+ 14·5	19	·155	+ 14·2	14	·139	·147
+ 49·4	10	·166	+ 50·1	10	·104	·135
+ 72·9	10	·129	+ 75·9	15	·147	·138

The mean of all the stars observed at Cambridge gives R — M = ·154 sec $^{\frac{3}{4}}\delta$, and at Montreal, R — M = ·130 sec $^{\frac{3}{4}}\delta$. These values have been employed in computing the personal equation correction in Table VIII.

Computation of Clock Errors.

Level Errors.—The adopted values of the inclination of the axis have been derived from the observed values by plotting the latter and drawing a smooth curve to pass as nearly as possible through the middle points of the straight lines joining adjacent observations. The observed and adopted values are entered in Table II.

Reduction of Observations.—The method of reducing the observations was as follows:—

The observed times of transit were corrected for level and for approximate values of the azimuth, collimation and clock error. These values were obtained somewhat after the method of equations between a and c, discussed by Professor Rogers. Corrections to these values were then obtained by the method of least squares. In forming the normals, the equations of conditions have been multiplied by the weight factor $w_1 = \sqrt{\frac{12\cdot 35}{10 + 2 \sec Z \sec^2 \delta}}$. The values of w_1 for Montreal and Cambridge are given in Table I. This formula is due to Professor C. A. Young, and is a modification—taking into account the zenith distance of the star—of those proposed by Struve and Safford. Where stars were not fully observed the equations were also multiplied by the factor $w_2 = \sqrt{\frac{1 + \frac{1\cdot 6}{N}}{1 + \frac{1\cdot 6}{n}}}$ where N is the number of wires in the reticule and n the number observed. (See Chauvenet's Astronomy, Vol. II. p. 198.) The collimation is assumed to have been constant throughout the work of a single night, and on no night do the residuals appear to throw any doubt on the validity of this assumption. The azimuth error was assumed to have been different in each position of the instrument, but to have been constant while in any one position.

Let ϕ = latitude of the place of observation.
δ = declination of an observed star.
α = tabular right ascension, corrected for diurnal aberration.
$A = \sin(\phi - \delta) \sec \delta$.
$B = \cos(\phi - \delta) \sec \delta$.
$C = \sec \delta$.
a, a', a'' = approximate values of azimuth.
b = level error at time of observation.
c = approximate collimation error.
T = mean of observed times, reduced to mean wire.
θ = reduction for clock rate.
t = approximate clock error. This was generally taken as the arithmetical mean of

$$\alpha - (T + Aa + Bb + Cc \pm \theta)$$

for all the stars observed in one night.

da, da', da'', dc, dt = corrections to a, a', a'', c and t.

Then,

$$\alpha = T + A\,(a + da) + Bb + C\,(c + dc) + (t + dt) \pm \theta$$

or, if $D = \alpha - (T + Aa + Bb + Cc + t \pm \theta)$,

$$A\,da + C\,dc + dt - D = 0.$$

The equations of condition are entered in Table III. in this form. In this table the last column gives the residuals from the equation of condition after weighting.

Professor G. H. Chandler, M.A., has shared with me the work of these reductions

Table I.—Weight Factors.

δ	w_1 Montreal.	w_1 Cambridge.	δ	w_1 Montreal.	w_1 Cambridge.	δ	w_1 Montreal.	w_1 Cambridge.	δ	w_1 Montreal.	w_1 Cambridge.
− 30°	0.78	0.81	+ 60°	0.82	0.82	+ 79°	0.40	0.39	+ 108°	0.47	0.45
− 25	0.84	0.86	+ 62	0.80	0.80	+ 80	0.37	0.36	+ 109	0.49	0.46
− 20	0.89	0.91	+ 64	0.78	0.77	+ 81	0.34	0.33	+ 110	0.50	0.47
− 10	0.95	0.96	+ 66	0.75	0.74	+ 82	0.30	0.29	+ 111	0.51	0.48
0	0.97	0.98	+ 68	0.71	0.70	+ 100	0.32	0.30	+ 112	0.52	0.49
+ 10	0.99	0.99	+ 70	0.66	0.65	+ 101	0.34	0.32	+ 113	0.53	0.50
+ 20	0.99	1.00	+ 72	0.61	0.60	+ 102	0.36	0.34	+ 114	0.54	0.50
+ 30	0.98	0.98	+ 74	0.56	0.55	+ 103	0.38	0.36	+ 115	0.54	0.50
+ 40	0.96	0.96	+ 75	0.53	0.52	+ 104	0.40	0.38	+ 116	0.54	0.50
+ 45	0.94	0.94	+ 76	0.50	0.49	+ 105	0.42	0.40	+ 117	0.55	0.50
+ 50	0.91	0.91	+ 77	0.47	0.46	+ 106	0.44	0.42	+ 118	0.55	0.50
+ 55	0.87	0.87	+ 78	0.44	0.43	+ 107	0.46	0.44	+ 119	0.56	0.51

Table II.—Level Corrections.

Sidereal Time.		Observed.	Adopted.
Montreal Transit.			
1883.	h.	s.	s.
June 2,	12.5	− 0.197	− 0.18
	12.8		− 0.17
	13.1	− 0.146	− 0.15
	13.3		− 0.13
	13.6	− 0.089	− 0.10
	13.9		− 0.10
	14.2	− 0.109	− 0.11
	14.4	− 0.118	− 0.11
	14.5	− 0.109	− 0.11
Reversed.			
	16.8	− 0.219	− 0.20
	17.0	− 0.164	− 0.18
	17.5	− 0.173	− 0.16
Reversed.			
	18.0	− 0.100	− 0.10
	18.5		− 0.10
	18.7	− 0.091	− 0.11
	19.1		− 0.13
	19.4	− 0.174	− 0.17
June 4,	12.7	− 0.219	− 0.22
	13.2		− 0.25
	13.7	− 0.274	− 0.27
	14.0	− 0.255	− 0.26
Reversed.			
	14.2		− 0.25
	14.5	− 0.237	− 0.24
	14.8		− 0.23
	16.0	− 0.219	− 0.22
	16.3		− 0.21
	16.7	− 0.210	− 0.21
Reversed.			
	17.0	− 0.255	− 0.25
	17.3	− 0.255	− 0.25
	17.8	− 0.255	− 0.25

Sidereal Time.		Observed.	Adopted.
Montreal Transit.			
1883.	h.	s.	s.
June 5,	12.8	− 0.266	− 0.27
	13.2		− 0.28
	13.5	− 0.285	− 0.28
	13.8		− 0.28
	14.1	− 0.274	− 0.28
Reversed.			
	14.4	− 0.292	− 0.29
	14.8		− 0.29
Cambridge Transit.			
	h.	s.	s.
June 20,	16.7	− 0.162	− 0.21
	17.1		− 0.22
	17.5	− 0.234	− 0.24
	17.8	− 0.260	− 0.25
	17.9	− 0.282	− 0.25
	18.0	− 0.269	− 0.25
	18.6	− 0.217	− 0.23
	18.9	− 0.207	− 0.21
Reversed.			
	19.0	− 0.211	− 0.20
	19.1	− 0.156	− 0.16
	19.4	− 0.065	− 0.08
	19.7		− 0.03
	20.0	− 0.003	− 0.01
	20.3		0.00
	20.7	0.000	0.00
	21.1		+ 0.01
	21.5	+ 0.016	+ 0.01
June 21,	14.7	− 0.182	....
	14.8		− 0.08
	15.0	+ 0.051	0.00
	15.3		+ 0.09
	15.6	+ 0.166	+ 0.12
	16.0	+ 0.236	+ 0.16

Sidereal Time.		Observed.	Adopted.
Cambridge Transit.			
1883.	h.	s.	s.
June 21,	16.3	+ 0.159	+ 0.15
Reversed.			
	16.5	+ 0.150	....
	17.1	− 0.071	− 0.04
	17.2	− 0.045	− 0.05
	17.5	− 0.078	− 0.07
	17.8	− 0.107	− 0.10
	17.9	− 0.097	− 0.10
	18.3		− 0.11
	18.6	− 0.133	− 0.10
	18.8	− 0.070	− 0.07
June 23,	14.1	− 0.064	....
	14.5		− 0.05
	14.9	− 0.068	+ 0.01
	15.0	+ 0.048	+ 0.02
	15.2		+ 0.05
	15.5	+ 0.094	+ 0.07
	15.6	+ 0.120	+ 0.07
	16.0	+ 0.013	+ 0.04
	16.1	+ 0.009	+ 0.03
Reversed.			
	18.0	− 0.026	− 0.03
	18.4		− 0.05
	18.7	− 0.039	− 0.08
	18.9		− 0.12
	19.1	− 0.188	− 0.14
	19.5		− 0.17
	20.0		− 0.19
	20.5	− 0.190	− 0.21
	20.8		− 0.22
	21.2	− 0.237	− 0.23
	21.7		− 0.24
	22.2	− 0.243	− 0.23
	22.5	− 0.207	− 0.21

Table III.—Observations of June 2nd, 1883, Montreal.

Name of Star.	δ	Wires.	$w_1 w_2$	Transit over Mean Wire.	α	Bb	Equations of Condition.	$w_1 w_2 v$
LAMP WEST.								
	° ′			h. m. s.	s.	s.		
θ Virginis	− 4 55	15	.96	8 19 16.95	56.27	− 0.09	$+ 0.77da + 1.00dc + dt + .13 = 0$	+ .04
γ Hydræ	− 22 34	15	.88	8 28 56.06	36.77	− .06	$+ 1.00da + 1.08dc + dt + .13 = 0$	+ .03
α Virginis	− 10 33	15	.95	8 34 22.85	04.68	− .07	$+ 0.84da + 1.02dc + dt + .13 = 0$	+ .04
κ Virginis	− 9 44	15	.95	9 21 52.77	42.44	− .06	$+ 0.83da + 1.01dc + dt + .11 = 0$	+ .02
ε Virginis	+ 11 35	15	.99	8 11 45.60	23.67	− .14	$+ 0.57da + 1.02dc + dt + .09 = 0$	+ .03
ε Ursæ Maj.	+ 56 35	15	.86	8 04 18.04	54.85	− .31	$- 0.35da + 1.82dc + dt + .00 = 0$	− .02
Gr. 2001	+ 73 00	15	.58	8 38 28.75	11.38	− .35	$- 1.58da + 3.42dc + dt - .10 = 0$	− .04
40 Cassiop.	+ 107 33	13	.46	8 44 29.01	12.82	+ .17	$+ 2.93da - 3.32dc + dt - .12 = 0$	− .12
α Draconis	+ 64 56	13	.76	9 16 26.65	15.77	− .22	$- 0.79da + 2.36dc + dt - .31 = 0$	− .24
4 Ursæ Min.	+ 78 06	11	.43	9 24 31.82	22.09	− .42	$- 2.61da + 4.85dc + dt - .22 = 0$	− .06
36 H. Cassiop.	+ 107 42	9	.46	9 42 03.77	57.26	+ .18	$+ 2.91da - 3.29dc + dt - .32 = 0$	− .20
LAMP EAST.								
θ Ophiuchi	− 24 53	15	.84	12 29 32.53	53.32	− 0.05	$+ 1.04da' - 1.10dc + dt - .10 = 0$	− .07
κ Ophiuchi	+ 9 33	15	.99	12 06 54.25	10.99	− .16	$+ 0.59da' - 1.01dc + dt + .05 = 0$	+ .07
α Ophiuchi	+ 12 39	5	.91	12 44 10.46	33.33	− .14	$+ 0.55da' - 1.03dc + dt + .09 = 0$	+ .09
α Herculis, pr.	+ 14 31	15	.99	12 24 02.30	21.85	− .16	$+ 0.53da' - 1.03dc + dt + .07 = 0$	+ .08
β Draconis	+ 52 23	14	.89	12 42 27.76	50.38	− .26	$- 0.20da' - 1.64dc + dt - .05 = 0$	− .02
μ Herculis	+ 27 47	15	.98	12 56 30.91	55.79	− .16	$+ 0.34da' - 1.13dc + dt + .11 = 0$	+ .12
ε Ursæ Min.	+ 82 14	13	.30	12 12 48.43	05.08	− 1.13	$- 4.43da' - 7.40dc + dt + .02 = 0$	+ .05
19 H. Camelop.	+ 100 54	11	.33	12 17 58.02	17.30	+ 0.52	$+ 4.35da' + 5.29dc + dt + .05 = 0$	− .03
Gr. 966	+ 105 02	13	.42	12 38 42.63	05.30	+ .32	$+ 3.32da' + 3.86dc + dt - .12 = 0$	− .09
ω Draconis	+ 68 49	8	.66	12 52 17.67	41.64	− .38	$- 1.10da' - 2.77dc + dt + .10 = 0$	+ .10
Ψ Draconis Aus.	+ 72 12	13	.53	12 58 39.32	04.78	− .41	$- 1.47da' - 3.27dc + dt - .37 = 0$	− .18
LAMP WEST.								
γ Sagittarii	− 30 25	15	.78	13 12 53.95	21.49	− 0.03	$+ 1.13da'' + 1.16dc + dt + .32 = 0$	+ .28
λ Sagittarii	− 25 29	14	.84	13 35 17.25	48.74	− .04	$+ 1.05da'' + 1.11dc + dt + .10 = 0$	+ .02
Scuti 3 H.	− 8 19	15	.95	13 43 20.99	53.72	− .06	$+ 0.81da'' + 1.01dc + dt + .12 = 0$	+ .04
ζ Aquilæ	+ 13 41	14	.99	14 14 27.02	04.91	− .11	$+ 0.51da'' + 1.03dc + dt + .03 = 0$	+ .02
ξ Draconis	+ 56 53	14	.85	13 06 06.67	33.56	− .18	$- 0.35da'' + 1.83dc + dt - .25 = 0$	− .23
γ Draconis	+ 51 30	15	.90	13 08 29.23	56.34	− .16	$- 0.16da'' + 1.61dc + dt - .07 = 0$	− .08
ο Herculis	+ 28 45	15	.98	13 17 33.12	01.74	− .11	$+ 0.33da'' + 1.14dc + dt - .05 = 0$	− .10
β Lyræ	+ 33 14	15	.97	14 00 13.14	48.55	− .13	$+ 0.25da'' + 1.20dc + dt + .18 = 0$	+ .13
γ Lyræ	+ 32 32	15	.97	14 08 59.93	36.91	− .14	$+ 0.27da'' + 1.19dc + dt + .04 = 0$	.00
ι Lyræ	+ 35 55	15	.97	14 17 32.27	10.51	− .16	$+ 0.20da'' + 1.23dc + dt + .16 = 0$	+ .11
22 H. Camelop.	+ 110 38	13	.50	13 20 23.48	57.56	+ .12	$+ 2.57da'' - 2.84dc + dt + .03 = 0$	− .01
χ Draconis	+ 72 41	12	.59	13 37 41.93	13.63	− .30	$- 1.51da'' + 3.36dc + dt + .15 = 0$	+ .08
50 Draconis	+ 75 18	13	.52	14 04 36.55	12.31	− .41	$- 1.96da'' + 3.91dc + dt + .39 = 0$	+ .10
δ Draconis	+ 67 27	13	.71	14 26 54.98	34.85	− .34	$- 0.98da'' + 2.61dc + dt - .04 = 0$	− .04
τ Draconis	+ 73 08	13	.57	14 32 10.88	51.49	− .46	$- 1.60da'' + 3.45dc + dt - .00 = 0$	.00
Adopted Clock rate = + 0ˢ.025 per hour.								

NORMAL EQUATIONS.

$$0 = + 9.068da - 6.151dc + 3.055dt + .430,$$
$$0 = + 8.819da' + 8.257dc + 2.103dt + .172,$$
$$0 = + 7.620da'' - 5.419dc + 1.840dt + .285,$$
$$0 = - 6.151da + 8.257da' - 5.419da'' + 79.059dc + 14.667dt + 1.040,$$
$$0 = + 3.055da + 2.103da' + 1.840da'' + 14.667dc + 23.356dt + 0.884.$$

Whence, $da = - .060$; $da' = + .001$; $da'' - .048$; $dc = - .020$; $dt = - .006$; and weight of $dt = 17.29$.

Assumed values: $a = - .020$; $a' = - .040$; $a'' = - .020$; $c = + .030$; $t = + 2.030$.

Whence, total azimuth, $(a + da) = - .080$; $(a' + da') = - .039$; $(a'' + da'') = - .068$;

Collimation (Lamp West), $(c + dc) = + .010$;

Clock error at 16h. $(t + dt) = + 2^s.024$;

and probable error $\pm$ .018.

Table III *continued.*—Observations of June 4th, 1883, Montreal.

Name of Star.	δ	Wires.	$w_1 w_2$	Transit over Mean Wire.	α	Bb	Equations of Condition.	$w_1 w_2 v$
				LAMP EAST.				
	° ′			h. m. s.	s.	s.		
γ Hydræ	− 22 34	15	.86	8 29 03.21	36.75	− 0.10	$+ 1.00da - 1.08dc + dt + .14 = 0$	+ .05
α Virginis	− 10 33	15	.95	8 26 29.98	04.67	− .14	$+ 0.84da - 1.02dc + dt + .05 = 0$	− .01
ε Virginis	+ 11 35	15	.99	8 03 52.65	23.65	− .20	$+ 0.57da - 1.02dc + dt + .09 = 0$	− .06
η Bootis	+ 18 59	15	.99	8 56 29 93	09.48	− .26	$+ 0.47da - 1.06dc + dt + .06 = 0$	.00
11 Bootis	+ 27 57	15	.97	9 03 14.14	54 76	− .29	$+ 0.34da - 1.13dc + dt + .08 = 0$	+ .03
ε Ursæ Maj.	+ 56 35	15	.86	7 58 25.14	54.81	− .41	$- 0.35da - 1.82dc + dt - .05 = 0$	− .07
Gr. 2001	+ 73 00	13	.57	8 30 36.39	11.29	− .77	$- 1.58da - 3.42dc + dt + .04 = 0$	− .04
40 Cassiop.	+ 107 33	13	.47	8 36 35.93	12.92	+ .40	$+ 2.93da + 3.32dc + dt + .01 = 0$	− .03
50 Cassiop.	+ 108 09	15	.47	9 00 48.49	29.45	+ .39	$+ 2.85da + 3.21dc + dt + .02 = 0$	− .03
α Draconis	+ 64 56	15	.77	9 08 34.29	15.73	− .58	$- 0.79da - 2.36dc + dt - .10 = 0$	− .10
				LAMP WEST.				
α Libræ	− 15 33	15	.92	9 51 38.69	27.89	− .12	$+ 0.91da' + 1.04dc + dt - .02 = 0$	− .04
δ Ophiuchi	− 3 24	15	.95	11 15 13.47	16.20	− .14	$+ 0.76da' + 1.01dc + dt + .09 = 0$	+ .07
ε Ophiuchi	− 4 24	15	.95	11 19 07.89	11.22	− .14	$+ 0.77da' + 1.00dc + dt + .04 = 0$	+ .02
π Bootis	+ 16 55	5	.91	9 42 29 11	16.50	− .22	$+ 0.50da' + 1.04dc + dt + .08 = 0$	+ .06
γ Herculis	+ 19 26	15	.99	11 23 44.49	48.55	− .20	$+ 0.47da' + 1.06dc + dt + .07 = 0$	+ .06
β Herculis	+ 21 45	15	.99	11 32 09.04	14.43	− .21	$+ 0.43da' + 1.08dc + dt + .15 = 0$	+ .14
Gr. 2164	+ 59 46	15	.82	9 55 41.25	30.85	− .46	$- 0.49da' + 1.99dc + dt - .14 = 0$	− .19
η Herculis	+ 39 09	15	.96	11 45 48 27	56.05	− .27	$+ 0.15da' + 1.29dc + dt - .04 = 0$	− .04
4 Ursæ Min.	+ 78 06	11	.43	9 16 39.41	21.99	− 1.02	$- 2.61da' + 4.85dc + dt + .04 = 0$	+ .05
36 H. Cassiop.	+ 107 42	13	.47	9 34 11.13	57 34	+ .37	$+ 2.91da' - 3.29dc + dt + .24 = 0$	+ .06
19 Ursæ Min.	+ 76 10	13	.50	11 21 10.45	13.94	− .77	$- 2.13da' + 4.18dc + dt - .19 = 0$	− .06
A Draconis	+ 69 01	13	.67	11 35 10.11	16.07	− .54	$- 1.11da' + 2.79dc + dt - .18 = 0$	− .09
Gr. 2848	+ 104 16	13	.40	11 39 59.25	06.99	+ .44	$+ 3.47da' - 4.06dc + dt - .46 = 0$	− .24
				LAMP EAST.				
θ Ophiuchi	− 24 53	15	.84	12 21 39.97	53.34	− .09	$+ 1.04da'' - 1.10dc + dt + .17 = 0$	+ .09
49 Herculis	+ 15 10	15	.99	11 53 39.64	48 38	− .23	$+ 0.52da'' - 1.04dc + dt + .10 = 0$	+ .05
α Herculis	+ 14 31	15	.99	12 16 09.37	21.87	− .23	$+ 0.53da'' - 1.03dc + dt + .03 = 0$	− .02
α Ophiuchi	+ 12 39	5	.91	12 36 17.67	33.35	− .23	$+ 0.55da'' - 1.02dc + dt + .18 = 0$	+ .11
μ Herculis	+ 27 47	15	.98	12 48 38.07	55.81	− .28	$+ 0.34da'' - 1.13dc + dt + .11 = 0$	+ .06
β Draconis	+ 52 23	13	.89	12 34 31.97	50.38	− .42	$- 0.20da'' - 1.64dc + dt - .03 = 0$	− .07
ξ Draconis	+ 56 53	15	.85	12 58 14.23	33.59	− .45	$- 0.37da'' - 1.82dc + dt - .12 = 0$	− .13
γ Draconis	+ 51 30	15	.90	13 00 36.85	55.37	− .41	$- 0.17da'' - 1.61dc + dt + .15 = 0$	+ .09
ε Ursæ Min.	+ 82 14	13	.30	12 04 55.52	05.09	− 1.51	$- 4.43da'' - 7.40dc + dt - .31 = 0$	− .10
19 H. Camelop.	+ 100 54	13	.34	12 10 04.42	17.35	+ .76	$+ 4.35da'' + 5.29dc + dt - .17 = 0$	− .03
Gr. 966	+ 105 02	12	.42	12 30 49.07	05.32	+ .50	$+ 3.32da'' + 3.86dc + dt - .37 = 0$	− .16
ω Draconis	+ 68 49	15	.70	12 44 25.04	41.63	− .65	$- 1.10da'' - 2.77dc + dt + .19 = 0$	+ .10
Ψ Draconis Aus.	+ 72 12	13	.69	12 50 47.12	04.81	− .74	$- 1.47da'' - 3.27dc + dt - .01 = 0$	− .03

Adopted Clock rate = + $0^s.020$ per hour.

NORMAL EQUATIONS.

$$0 = + 6.996da + 4.514dc + 2.877dt + .246$$
$$0 = + 9.310da' - 7.178dc + 2.982dt + .308$$
$$0 = + 9.048da'' + 9.316dc + 1.600dt + .043$$
$$0 = + 4.514da - 7.178da' + 9.346da'' + 76.855dc - 7.771dt - 1.125$$
$$0 = + 2.877da + 2.982da' + 1.600da'' - 7.771dc + 22.990dt + 0.828$$

Whence, $da = - .036$; $da' = - .013$; $da'' = - .022$; $dc = + .016$; $dt = - .023$; and weight of $dt = 19.05$

Assumed values: $a = - .140$; $a' = + .040$; $a'' = - .070$; $c = + .080$; $t = + 3.280$

Whence, total azimuth $(a + da) = - .176$; $(a' + da') = + .027$; $(a'' + da'') = - .092$

Collimation (Lamp West), $(c + dc) = + .096$

Clock error at 16h. $(t + dt) = + 3^s.257$

and probable error $\pm$ .016

Table III *continued.*—Observations of June 5th, 1883, Montreal.

Name of Star.	δ	Wires.	$w_1 w_2$	Transit over Mean Wire.	α	Bb	Equations of Condition.	$w_1 w_2 r$
LAMP EAST.								
	° ′			h. m. s.	s.	s.		s.
θ Virginis - - - -	− 4 55	15	.96	8 07 27.86	56.24	− 0.18	$+0.77da - 1.00dc + dt - .01 = 0$	+ .02
γ Hydræ - - - -	− 22 33	15	.86	8 16 07.05	36.74	− .11	$+1.00da - 1.08dc + dt + .12 = 0$	+ .13
α Virginis - - - -	− 10 33	15	.95	8 22 33 87	04.66	− .16	$+0.84da - 1.02dc + dt + .07 = 0$	+ .10
43 Comæ Ber. - - -	+ 28 28	15	.98	8 09 58.47	27.15	− .39	$+0.33da - 1.14dc + dt - .06 = 0$	− .03
η Bootis - - - - -	+ 18 59	15	.99	8 52 33 69	09.47	− .27	$+0.47da - 1.06dc + dt - .09 = 0$	− .07
11 Bootis - - - - -	+ 27 57	15	.98	8 59 18.05	54 75	− .30	$+0.34da - 1.13dc + dt + .04 = 0$	+ .07
η Ursæ Maj. - - -	+ 49 54	14	.91	8 46 23.69	58.15	− .43	$-0.12da - 1.55dc + dt - .17 = 0$	− .12
40 Cassiop. - - - -	+ 107 33	13	.47	8 32 38.18	13.64	+ .43	$+2.93da + 3.32dc + dt + .18 = 0$	+ .06
50 Cassiop. - - - -	+ 108 09	13	.47	8 56 50.27	29.51	+ .41	$+2.85da + 3.21dc + dt - .26 = 0$	− .15
α Draconis - - - -	+ 64 56	15	.77	9 04 39 00	15.69	− .62	$-0.79da - 2.36dc + dt + .06 = 0$	+ .08
4 Ursæ Min. - - -	+ 78 06	13	.44	9 12 45.56	21.92	− 1.15	$-2.61da - 4.85dc + dt + .00 = 0$	+ .04
LAMP WEST.								
109 Virginis - - - -	+ 2 23	15	.98	9 43 38.01	23.06	− 0.21	$+0.68da' + 1.00dc + dt + .18 = 0$	+ .11
α Libræ - - - - -	− 15 33	15	.92	9 47 42.05	27.80	− .15	$+0.91da' + 1.04dc + dt + .25 = 0$	+ .16
Gr. 2164 - - - - -	+ 59 46	15	.82	9 51 44.27	30.84	− .56	$-0.49da' + 1.99dc + dt - .06 = 0$	− .03
ι Cassiop. - - - -	+ 113 08	13	.52	9 22 47.64	27.84	+ .28	$+2.35da' - 2.55dc + dt + .16 = 0$	− .04
36 H. Cassiop. - - -	+ 107 42	13	.47	9 39 15.22	57.42	+ .44	$+2.91da' - 3.29dc + dt - .20 = 0$	− .18
β Ursæ Min. - - -	+ 74 38	13	.54	9 54 18.86	06.31	− .92	$-1.84da' + 3.77dc + dt - .26 = 0$	− .08

Adopted Clock rate $= +0^s.015$ per hour.

NORMAL EQUATIONS.

$$0 = +7.754da + 4.369dc + 3.622dt + .023$$
$$0 = +5.660da' - 4.955dc + 1.845dt + .386$$
$$0 = +4.369da - 4.955da' + 33.739dc - 5.185dt + .159$$
$$0 = +3.622da + 1.845da' - 5.185dc + 10.782dt + .163$$

Whence, $da = +.002$; $da' = -.085$; $dc = -.016$; $dt = +.008$; weight of $dt = 7.32$

Assumed values: $a = -.040$; $a' = +.150$; $c = +.470$; $t = +3.770$

Whence, total azimuth $(a + da) = -.038$; $(a' + da') = +.065$

Collimation (Lamp West), $(c + dc) = +.454$

Clock error at 14h. $(t + dt) = +3^s.778$

and probable error $= \pm .028$,

Table III *continued.*—OBSERVATIONS OF JUNE 20TH, 1883, CAMBRIDGE.

Name of Star.	δ	Wires.	$w_1 w_2$	Transit over Mean Wire.	α	Bb	Equations of Condition.	$w_1 w_2 v$
CIRCLE EAST.								
	° ′			h. m. s.	s.	s.		s.
θ Ophiuchi	— 24 52	17	.84	17 15 03.84	53.53	— 0.10	$+ 1.02da - 1.10dc + dt + .05 = 0$	+ .12
σ Sagittarii	— 26 26	15	.83	18 48 14.77	04.63	— .09	$+ 1.04da - 1.12dc + dt - .10 = 0$	.00
α Herculis	+ 14 31	12	.97	17 09 32.07	22.00	— .21	$+ 0.48da - 1.03dc + dt - .09 = 0$	— .01
μ Herculis	+ 27 47	25	.99	17 42 06.06	55.96	— .23	$+ 0.28da - 1.13dc + dt - .03 = 0$	+ .06
o Herculis	+ 28 45	25	.99	18 03 12.10	01.92	— .28	$+ 0.27da - 1.14dc + dt + .06 = 0$	+ .15
β Lyræ	+ 33 14	25	.98	18 45 58.82	48.83	— .26	$+ 0.19da - 1.20dc + dt - .03 = 0$	+ .06
β Draconis	+ 52 23	21	.89	17 28 00.19	50.47	— .40	$- 0.29da - 1.64dc + dt - .20 = 0$	— .07
ξ Draconis	+ 56 53	25	.85	17 51 43.14	33.72	— .44	$- 0.45da - 1.83dc + dt - .44 = 0$	— .26
b Draconis	+ 58 44	25	.83	18 21 25.02	15.41	— .46	$- 0.54da - 1.93dc + dt - .21 = 0$	— .05
o Draconis	+ 59 15	8	.78	18 49 41.45	31.89	— .40	$- 0.57da - 1.96dc + dt - .18 = 0$	— .03
19 H. Camelop.	+ 100 54	7	.30	17 03 30.35	18.04	+ .60	$+ 4.51da + 5.29dc + dt + .09 = 0$	— .06
ω Draconis	+ 68 49	25	.68	17 37 50.90	41.67	— .62	$- 1.24da - 2.77dc + dt - .31 = 0$	— .08
22 H. Camelop.	+ 110 39	10	.64	18 06 09.17	57.71	+ .26	$+ 2.64da + 2.84dc + dt + .13 = 0$	— .02
23 H. Camelop.	+ 100 19	9	.28	18 26 25.73	13.80	+ .71	$+ 4.73da + 5.58dc + dt - .33 = 0$	— .18
CIRCLE WEST.								
π Sagittarii	— 21 12	19	.89	19 03 02.93	52.16	— .10	$+ 0.96da' + 1.07dc + dt + .12 = 0$	+ .02
v Capricorni	— 18 33	15	.90	20 33 37.38	26.71	.00	$+ 0.92da' + 1.05dc + dt + .13 = 0$	+ .03
ν Aquarii	— 11 51	13	.92	21 03 26.93	16.37	.00	$+ 0.83da' + 1.02dc + dt + .08 = 0$	— .01
ξ Capricorni	— 22 54	25	.88	21 20 12.78	02.34	.00	$+ 0.99da' + 1.09dc + dt - .13 = 0$	— .20
α Aquilæ	+ 8 34	18	.93	19 45 18.30	07.77	— .02	$+ 0.56da' + 1.01dc + dt + .13 = 0$	+ .05
ζ Cygni	+ 29 45	20	.97	21 08 10.76	00.46	.00	$+ 0.25da' + 1.15dc + dt + .02 = 0$	— .05
θ Lyræ	+ 37 56	24	.96	19 12 32.29	21.61	— .20	$+ 0.10da' + 1.27dc + dt + .23 = 0$	+ .14
θ Cygni	+ 49 57	23	.91	19 33 32.04	21.55	— .08	$- 0.20da' + 1.55dc + dt + .22 = 0$	+ .12
δ Cygni	+ 44 51	25	.94	19 41 32.75	22.38	— .04	$- 0.06da' + 1.41dc + dt + .12 = 0$	+ .03
κ Cephei	+ 77 22	13	.44	20 13 03.67	53.59	.00	$- 2.62da' + 4.57dc + dt + .27 = 0$	+ .04
θ Cephei	+ 62 36	25	.79	20 27 51.07	40.68	.00	$- 0.75da' + 2.17dc + dt + .31 = 0$	+ .16
σ^2 Ursae maj.	+ 112 24	25	.49	21 00 15.59	04.98	.00	$+ 2.47da' - 2.62dc + dt + .19 = 0$	+ .13
α Cephei	+ 62 06	24	.80	21 16 00.70	50.85	+ .02	$- 0.72da' + 2.14dc + dt - .20 = 0$	— .24

Adopted clock rate = + $0^s.005$ per hour.

NORMAL EQUATIONS.

$$0 = + 9.622da + 8.322dc + 2.638dt + 0.484.$$
$$0 = + 6.622da' - 2.127dc + 2.773dt + 0.127.$$
$$0 = + 8.322da - 2.127da' + 50.484dc + 1.884dt + 3.190.$$
$$0 = + 2.638da + 2.773da' + 1.884dc + 18.554dt + 0.023.$$

Whence, $da = + .003$; $da' = - .046$; $dc = - .066$; $dt = + .013$; weight of $dt = 16.66$.

Assumed values: $a = - .400$; $a' = - .400$; $c = - .200$; $t = - 9.960$.

Whence, total azimuth $(a + da) = - .397$; $(a' + da') = - .446$.

Collimation (circle west), $(c + dc) = - .266$.

Clock error, $(t + dt)$ at 19h. $= - 9^s.947$.

And probable error $\pm$ .021.

Table III *continued.*—OBSERVATIONS OF JUNE 21ST, 1883, CAMBRIDGE.

Name of Star.	δ	Wires.	$w_1 w_2$	Transit over Mean Wire.	α	Bb	Equations of Condition.	$w_1 w_2 v$
CIRCLE WEST.								
	° ′			h. m. s.	s.	s.		s.
δ Scorpii	− 22 17	25	.89	15 53 30.26	28.80	+ 0.07	$+0.93da+1.08dc+dt-.06=0$	− .09
β^1 Scorpii	− 19 29	25	.91	15 58 52.33	41.84	+ .08	$+0.94da+1.06dc+dt+.02=0$	− .02
δ Ophiuchi	− 3 23	25	.97	16 08 26.68	16.27	+ .10	$+0.72da+1.00dc+dt+.08=0$	+ .04
α Serpentis	+ 6 48	25	.99	15 38 43.83	33.45	+ .10	$+0.59da+1.01dc+dt+.11=0$	+ .07
β Serpentis	+ 15 47	25	1.00	15 41 00.60	50.26	+ .12	$+0.47da+1.04dc+dt+.15=0$	+ .11
κ Serpentis	+ 18 30	25	1.00	15 43 41.67	31.40	+ .13	$+0.43da+1.05dc+dt+.11=0$	+ .07
γ Herculis	+ 19 26	20	.99	16 16 58.82	48.59	+ .14	$+0.41da+1.06dc+dt+.09=0$	+ .05
Gr. 2164	+ 59 45	20	.82	14 48 40.56	30.47	− .15	$-0.59da+1.99dc+dt-.04=0$	− .04
ν^1 Bootis	+ 41 14	23	.96	15 26 56.41	46.27	+ .14	$+0.03da+1.33dc+dt+.13=0$	+ .09
α Coronæ	+ 27 07	25	.99	15 29 57.02	46.88	+ .12	$+0.30da+1.12dc+dt+.03=0$	.00
47 H. Cephei	+ 101 02	15	.31	14 50 48.18	37.59	+ .20	$+4.46da-5.22dc+dt-.28=0$	− .13
48 H. Cephei	+ 102 42	15	.34	15 05 44.24	33.13	− .07	$+3.95da-4.55dc+dt+.11=0$	.00
1 H. Ursæ Min.	+ 67 48	20	.69	15 13 29.87	20.23	+ .14	$-1.13da+2.65dc+dt-.05=0$	− .03
γ Ursæ Min.	+ 72 15	25	.60	15 21 06.98	57.80	+ .25	$-1.64da+3.28dc+dt-.28=0$	− .16
ζ Ursæ Min.	+ 78 09	15	.42	15 48 26.84	18.25	+ .55	$-2.85da+4.86dc+dt-.27=0$	− .09
19 Ursæ Min.	+ 76 10	9	.47	16 14 22.55	13.35	+ .52	$-2.33da+4.18dc+dt+.17=0$	+ .10
CIRCLE EAST.								
θ Ophiuchi	− 24 53	25	.86	17 15 04.02	53.54	− .02	$+1.02da'-1.10dc+dt+.31=0$	+ .20
α Ophiuchi	+ 12 39	25	.99	17 29 43.68	33.52	− .06	$+0.50da'-1.02dc+dt+.19=0$	+ .14
α Herculis	+ 14 31	25	.99	17 09 32.05	22.01	− .04	$+0.48da'-1.03dc+dt+.11=0$	+ .06
μ Herculis	+ 27 48	25	.99	17 42 05.99	55.97	− .10	$+0.28da'-1.13dc+dt+.06=0$	+ .02
109 Herculis	+ 21 43	25	1.00	18 18 56.04	46.01	− .11	$+0.38da'-1.08dc+dt+.09=0$	+ .05
β Draconis	+ 52 23	5	.81	17 28 00.08	50.47	− .11	$-0.29da'-1.64dc+dt+.10=0$	+ .08
ξ Draconis	+ 56 54	25	.85	17 51 42.86	33.72	− .18	$-0.45da'-1.83dc+dt-.31=0$	− .26
γ Draconis	+ 51 30	9	.85	17 54 05.99	56.51	− .16	$-0.26da'-1.61dc+dt-.18=0$	− .16
o Herculis	+ 28 45	25	.98	18 03 11.82	01.93	− .11	$+0.27da'-1.14dc+dt+.02=0$	− .02
α Lyræ	+ 38 41	25	.97	18 33 11.61	01.85	− .13	$+0.08da'-1.28dc+dt-.01=0$	− 01
Gr. 966	+ 105 03	15	.51	17 24 17.79	05.79	+ .14	$+3.43da'+3.86dc+dt-.20=0$	− .20
ω Draconis	+ 68 49	25	.70	17 37 50.33	41.66	− .20	$-1.24da'-2.77dc+dt-.22=0$	− .13
22 H. Camelop.	+ 110 39	20	.48	18 06 09.38	57.73	+ .12	$+2.64da'+2.84dc+dt+.02=0$	− .06
23 H. Camelop.	+ 100 19	25	.30	18 26 26.84	13.81	+ .33	$+4.73da'+5.58dc+dt+.02=0$	− .07

Adopted clock rate = $+0^{s}.005$ per hour.

NORMAL EQUATIONS.

$$0 = +11.118da - 8.406dc + 2.775dt + 0.438.$$
$$0 = +9.233da' + 7.494dc + 3.330dt + 0.530.$$
$$0 = -8.406da + 7.494da' + 59.364dc + 3.573dt + 0.155.$$
$$0 = +2.775da + 3.330da' + 3.573dc + 20.291dt + 0.758.$$

Whence, $da = -.026$; $da' = -.049$; $dc = .000$; $dt = -.025$; weight of $dt = 17.52$.

Assumed values: $a = -.500$; $a' = -.500$; $c = -.200$; $t = -9.870$.

Whence, total azimuth $(a + da) = -.526$; $(a' + da') = -.549$.

Collimation (circle west), $(c + dc) = -.200$.

Clock error $(t + dt)$ at $16h. = -9^{s}.895$

And probable error $\pm .021$.

Table III *continued*.—Observations of June 23rd, 1883, Cambridge.

Name of Star.	δ	Wires.	$w_1 w_2$	Transit over Mean Wire.	α	Bb	Equations of Condition.	$w_1 w_2 v$
					CIRCLE WEST.			
	° ′			h. m. s.	s.	s.		s.
109 Virginis	+ 2 23	25	.98	14 49 32.84	22.99	− 0.02	$+0.64da + 1.01dc + dt - .05 = 0$	− .04
α^2 Libræ	− 15 33	25	.93	14 41 37.51	27.74	− .01	$+0.88da + 1.04dc + dt - .13 = 0$	− .12
δ Scorpii	− 22 17	25	.90	15 53 38.50	28.80	+ .02	$+0.98da + 1.08dc + dt - .17 = 0$	− .16
β^1 Scorpii	− 19 29	25	.91	15 58 51.54	41.84	+ .02	$+0.94da + 1.06dc + dt - .17 = 0$	− .16
δ Ophiuchi	− 3 24	25	.97	16 08 26.14	16.27	+ .02	$+0.72da + 1.00dc + dt + .02 = 0$	+ .02
π Bootis	+ 16 55	25	1.00	14 35 26.31	16.33	− .02	$+0.46da + 1.05dc + dt + .03 = 0$	+ .05
α Coronæ	+ 27 07	25	.99	15 29 56.70	46.87	+ .08	$+0.30da + 1.12dc + dt + .00 = 0$	+ .04
α Serpentis	+ 6 48	25	.99	15 38 43.30	33.44	+ .06	$+0.59da + 1.01dc + dt + .05 = 0$	+ .06
β Serpentis	+ 15 47	25	1.00	15 40 00.14	50.25	+ .06	$+0.47da + 1.04dc + dt + .07 = 0$	+ .09
κ Serpentis	+ 18 30	25	1.00	15 43 41.22	31.39	+ .07	$+0.43da + 1.05dc + dt + .02 = 0$	+ .05
Gr. 2164	+ 59 46	25	.82	14 48 40.51	30.42	.00	$-0.60da + 1.99dc + dt - .07 = 0$	+ .06
ν^1 Boötis	+ 41 14	25	.96	15 26 56.18	46.26	+ .09	$+0.03da + 1.33dc + dt + .04 = 0$	+ .11
ι Cassiop.	+113 08	7	.46	14 19 38.38	28.85	+ .06	$+2.40da - 2.55dc + dt + .77 = 0$	+ .22
36 H. Cassiop	+107 42	24	.45	14 26 07.72	58.66	+ .09	$+2.99da - 3.29dc + dt + .57 = 0$	+ .11
β Ursae Min.	+ 74 38	15	.52	14 51 15.73	05.39	.00	$-2.02da + 3.77dc + dt - .34 = 0$	.00
48 H. Cephei	+102 42	25	.36	15 05 42.09	33.30	− .09	$+3.96da - 4.55dc + dt + .49 = 0$	.00
1 H. Ursæ Min.	+ 67 48	23	.70	15 13 30.41	20.17	+ .12	$-1.13da + 2.65dc + dt + .00 = 0$	+ .15
γ Ursæ Min.	+ 72 15	25	.60	15 21 07.80	57.72	+ .17	$-1.64da + 3.28dc + dt - .30 = 0$	− .01
ζ Ursæ Min.	+ 78 09	15	.42	15 48 28.39	18.13	+ .26	$-2.85da + 4.87dc + dt - .51 = 0$	− .02
					CIRCLE EAST.			
ε Pegasi	+ 9 21	24	.99	21 33 38.92	29.37	− 0.20	$+0.55da' - 1.01dc + dt + .10 = 0$	+ .12
δ Capricorni	− 16 39	23	.93	21 40 47.37	38.01	− .13	$+0.90da' - 1.04dc + dt + .00 = 0$	+ .06
ι Aquarii	− 14 26	25	.94	22 00 19.41	09.96	− .13	$+0.86da' - 1.03dc + dt + .09 = 0$	+ .13
109 Herculis	+ 21 43	25	1.00	18 18 55.39	46.03	− .04	$+0.38da' - 1.08dc + dt + .08 = 0$	+ .09
α Aquilæ	+ 8 34	25	.99	19 45 17.23	07.23	− .15	$+0.56da' - 1.01dc + dt + .00 = 0$	+ .03
ζ Cygni	+ 29 45	25	.98	21 08 09.93	00.54	− .26	$+0.25da' - 1.15dc + dt - .07 = 0$	− .08
ξ Draconis	+ 56 53	25	.85	17 51 42.82	33.72	− .04	$-0.45da' - 1.83dc + dt + .05 = 0$	− .06
α Lyræ	+ 38 40	25	.96	18 33 11.20	01.87	− .08	$+0.08da' - 1.28dc + dt + .07 = 0$	+ .04
β Lyræ	+ 33 14	25	.97	18 45 58.26	48.87	− .11	$+0.19da' - 1.20dc + dt + .08 = 0$	+ .06
θ Lyræ	+ 37 55	10	.92	19 12 30.95	21.65	− .19	$+0.10da' - 1.27dc + dt - .06 = 0$	− .09
α Cygni	+ 44 52	25	.94	20 37 39.29	29.94	− .30	$-0.06da' - 1.41dc + dt - .08 = 0$	− .13
ε Cygni	+ 33 32	21	.96	20 41 41.13	31.87	− .25	$+0.18da' - 1.20dc + dt - .18 = 0$	− .19
61^1 Cygni	+ 38 11	22	.96	21 01 51.89	42.48	− .28	$+0.09da' - 1.27dc + dt - .03 = 0$	− .06
74 Cygni	+ 39 53	25	.96	21 32 28.24	18.76	− .31	$+0.06da' - 1.30dc + dt + .02 = 0$	− .02
3 Lacertæ	+ 51 39	25	.90	22 19 10.33	00.88	− .37	$-0.26da' - 1.61dc + dt + .02 = 0$	− .06
ε Draconis	+ 69 58	22	.65	19 48 47.36	37.98	− .39	$-1.37da' - 2.92dc + dt + .34 = 0$	+ .05
β Cephei	+ 70 03	21	.64	21 27 22.57	13.14	− .62	$-1.37da' - 2.93dc + dt + .15 = 0$	− .06
Gr. 1586	+106 34	25	.43	21 48 02.59	53.40	+ .37	$+3.16da' + 3.51dc + dt - 1.03 = 0$	− .22
24 Cephei	+ 71 46	15	.59	22 09 47.23	37.75	− .67	$-1.57da' - 3.19dc + dt + .23 = 0$	− .03

Adopted clock rate $= +0^s.005$ per hour.

NORMAL EQUATIONS.

$$0 = +13.543da - 8.197dc + 4.919dt + 1.351.$$
$$0 = +6.714da' + 3.956dc + 2.204dt - 0.910.$$
$$0 = -8.197da + 3.956da' + 70.291dc - 4.689dt - 4.141.$$
$$0 = +4.919da + 2.204da' - 4.689dc + 27.723dt - 0.020.$$

Whence, $da = -.077$; $da' = +.104$; $dc = +.045$; $dt = +.014$; weight of $dt = 25.06$.

Adopted values: $a = .000$; $a' = .000$; $c = -.300$; $t = -9^s.570$.

Whence, total azimuth $(a + da) = -.077$; $(a' + da') = +.104$.

Collimation $(c + dc)$, circle west, $= -.255$.

Clock error $(t + dt)$ at 16h. $= -9^s.556$.

And probable error $\pm .014$.

Table IV.—Azimuth and Collimation.

At Montreal.				At Cambridge.			
Date.	Position.	Total Azimuth.	Total Collimation.	Date.	Position.	Total Azimuth.	Total Collimation.
1883.		s.	s.	1883.		s.	s.
June 2 - - -	L. W.	— .080		June 20 - -	C. E.	— .397	— .266
" 2 - - -	L. E.	— .039	+ .010	" 20 - -	C. W.	— .446	
" 2 - - -	L. W.	— .068		" 21 - -	C. W.	— .526	— .200
" 4 - - -	L. E.	— .176		" 21 - -	C. E.	— .549	
" 4 - - -	L. W.	+ .027	+ .096	" 23 - -	C. W.	— .077	— .255
" 4 - - -	L. E.	— .092		" 23 - -	C. E.	+ .104	
" 5 - - -	L. E.	— .038	+ .454	The signs attached to the collimation are those which belong to L. W. and C. W.			
" 5 - - -	L. W.	+ .065					

Table V.—Clock Corrections and Rates.

Sidereal Time.	Clock correction.	Rate per hour.
Mean-time clock at Montreal.		
1883. h.	s. s.	
June 2 - - - - 16.0	+ 2.024 ± .018	+ .025
" 4 - - - - 16.0	+ 3.257 ± .016	+ .020
" 5 - - - - 14.0	+ 3.778 ± .028	+ .015
Sidereal clock at Cambridge.		
h.	s. s.	
June 20 - - - - 19.0	— 9.947 ± .021	+ .005
" 21 - - - - 16.0	— 9.895 ± .021	+ .005
" 23 - - - - 16.0	— 9.556 ± .014	+ .005

The clock corrections are in all cases in sidereal time.

LETTER OF TRANSMISSION.

HARVARD COLLEGE OBSERVATORY,

Cambridge, Nov. 2, 1885.

DEAR SIR: Professor Rogers has completed his reduction of the observations made in determining the difference of longitude between the observatories of McGill College and of Harvard College. I accordingly send you by express the papers containing the results of his work.

Yours respectfully,

EDWARD C. PICKERING.

PROFESSOR C. H. McLEOD,
Superintendent of the Observatory, McGill College,
Montreal, Canada.

PART II.

The instrument employed in the observations at the Cambridge station is a broken transit made by Herbst, the mechanician of the Pulkowa Observatory at St. Petersburgh, Russia. It is described on pages 28-29 in Vol. XVIII of the Annals of the Observatory. It has been in use since September, 1870, and it has served as the type of all the instruments of this class since constructed in the United States.

The following instrumental constants were determined at the Pulkowa Observatory:

Value of 1 division of the level $= 1''.93 \pm 0''.01$
Length of the bubble tube $= 36$ divisions.

Inequality of pivots determined by level readings taken at every 5 degrees from $-60°$ to $+60°$ zenith distance:

Circle East $+ 0.082$ in half divisions of the level.
Circle West $- 0.082$ " " "
Correction for Circle East $= + 0''.079$.

Value of 1 division of micrometer screw $= 0^s.0619$.

The reticule furnished with the instrument consisted of 11 spider line threads, but this has been replaced by a glass reticule consisting of 25 threads arranged in groups of 5 threads each. The values for the reduction of the mean of each group to the mean of all the groups, as obtained from 21 fully observed star transits between the declinations $-22°$ and $+72°$, with the *circle east*, are

$$+42^s.554, \ +21^s.257, \ -0^s.003, \ -21^s.277, \ -42^s.550$$

(The similar values for the Montreal transit, as obtained from 24 observations between $-22°$ and $+65°$, for *lamp east*, are $+32^s.753$, $+15^s.707$, $+0^s.001$, $-15^s.726$, $-32^s.740$).

Several determinations of the value of 1 division of the level have been made since the instrument was mounted, giving for the mean value 1 div. = $0^s.131$. The power employed was 102. The observations for inequality of pivots indicate that they have exactly the same diameter.

Clock.—The clock employed was Frodsham 1327.

Chronograph.—A Bond chronograph was used.

For a description of the instruments employed at the Montreal station, reference is made to the report of Professor McLeod.

The observing list of stars was selected with reference to the requirements stated in the discussion following, but, as nearly always happens, various circumstances combined to prevent a close adherence to the original scheme. It was the aim to obtain, for each position of the instrument, observations of at least,

2 stars having a large south declination.
2 stars situated near the equator.
4 stars symetrically situated with reference to the zenith of the observer.
2 polar stars at the upper culmination.
2 polar stars at the lower culmination.

The data derived from the observations are given in the following table. The apparent right ascensions of the stars are also given. They have been taken from the Berlin *Jahrbuch* for 1883.

The following corrections derived from more recent observations have been applied :—

Star.	Right Ascension. h.	m.	Correction to Ephemeris. s.
γ Hydræ	13	13	+ 0.13
Groombridge 2001	13	23	— 0.06
Groombridge 2164	14	48	+ 0.09
θ Draconis	16	00	— 0.09
η Draconis	16	22	— 0.16

The data derived from the observations are given on the following pages.

Level Observations.

Time.	Observed.	Time.	Adopted.
Cambridge, June 1, 1883.			
h.	s.	h.	s.
12.4	− 0.01	12.4	− 0.01
12.9	− 0.03	12.9	− 0.03
13.3	− 0.05	13.4	− 0.05
Cambridge, June 2.			
h.	s.	h.	s.
12.7	− 0.03	12.7	− 0.03
13.2	+ 0.06	13.0	− 0.03
13.3	+ 0.08		
13.6	+ 0.05	13.0	+ 0.05
13.8	+ 0.08	13.5	+ 0.07
13.9	+ 0.08	14.0	+ 0.08
14.1	+ 0.08	14.2	+ 0.09
*14.5	0.00	15.0	− 0.01
14.6	+ 0.01	15.5	− 0.03
15.0	− 0.03	16.0	− 0.05
16.7	− 0.05	16.5	− 0.08
16.9	− 0.12	17.0	− 0.10
16.9	− 0.11		
*17.3	+ 0.01	17.3	+ 0.01
17.4	− 0.01	17.4	− 0.01
17.4	− 0.01		
Cambridge, June 4.			
h.	s.	h.	s.
12.6	+ 0.05	12.0	+ 0.06
12.9	+ 0.01	12.5	+ 0.05
13.1	+ 0.01	13.0	+ 0.02
13.2	+ 0.04	13.5	0.00
13.3	− 0.02	14.0	− 0.01
13.4	− 0.01	14.5	− 0.01
13.5	0.00	15.0	+ 0.01
13.6	− 0.01	15.5	+ 0.02
13.8	− 0.01	16.0	+ 0.04
13.9	− 0.04	16.5	+ 0.03
14.0	− 0.04	17.0	− 0.01
14.3	0.00	17.5	− 0.03
14.4	0.00		
14.5	+ 0.01		
14.6	− 0.01		
14.9	+ 0.04		
15.9	− 0.01		
15.9	+ 0.07		
16.2	+ 0.07		
16.5	+ 0.04		
16.8	0.00		
17.2	− 0.03		
17.3	− 0.03		

Time.	Observed.	Time.	Adopted.
Cambridge, June 5, 1883.			
h.	s.	h.	s.
12.7	− 0.05	12.7	− 0.04
12.7	− 0.04	13.0	− 0.04
12.9	− 0.04	13.5	− 0.05
13.0	− 0.05	13.6	− 0.06
13.2	− 0.04	13.7	− 0.06
13.3	− 0.05	13.9	− 0.03
13.6	− 0.07	14.1	− 0.05
13.6	− 0.08	14.2	− 0.04
13.7	− 0.07	14.3	− 0.02
13.8	− 0.05	14.4	0.00
14.1	− 0.12	14.5	+ 0.02
14.1	− 0.12	14.6	+ 0.03
		14.7	+ 0.04
14.3	− 0.02	14.8	+ 0.05
14.5	+ 0.05	14.9	+ 0.05
14.6	+ 0.06	15.0	+ 0.06
14.9	+ 0.06	15.5	+ 0.07
15.3	+ 0.03	16.0	+ 0.08
15.4	+ 0.04	16.5	+ 0.09
16.2	+ 0.08		
16.2	+ 0.07		
16.5	+ 0.09		
Montreal, June 17.			
h.	s.	h.	s.
15.4	− 0.11	15.0	− 0.11
15.8	− 0.11	15.5	− 0.11
16.1	− 0.18	16.0	− 0.18
16.3	− 0.18	16.5	− 0.18
Montreal, June 19.			
h.	s.	h.	s.
14.0	+ 0.11	14.0	+ 0.11
14.2	+ 0.11	14.5	+ 0.13
14.4	+ 0.12	15.0	+ 0.15
14.6	+ 0.12	15.5	+ 0.17
14.8	+ 0.13		
15.0	+ 0.14		
15.2	+ 9.15		
15.4	+ 0.18		
15.6	+ 0.19		
15.8	+ 0.22		
16.0	+ 0.24		
Montreal, June 20.			
h.	s.	h.	s.
13.5	+ 0.09	13.5	+ 0.09
13.6	+ 0.10	13.6	+ 0.10
14.2	+ 0.13	13.8	+ 0.11
14.5	+ 0.17	14.0	+ 0.12
14.6	+ 0.19	14.1	+ 0.13

Time.	Observed.	Time.	Adopted.
Montreal, June 20, 1883.			
h.	s.	h.	s.
14.9	+ 0.19	14.2	+ 0.14
15.9	+ 0.18	14.3	+ 0.15
17.3	+ 0.22	14.4	+ 0.16
		14.5	+ 0.17
		15.0	+ 0.19
		15.5	+ 0.19
		16.0	+ 0.19
		16.5	+ 0.20
		17.0	+ 0.21
Montreal, June 21.			
h.	s.	h.	s.
14.0	0.00	14.0	− 0.01
14.2	− 0.01	14.5	− 0.01
15.0	0.00	15.0	+ 0.01
15.3	+ 0.05	15.1	+ 0.02
15.6	+ 0.04	15.2	+ 0.02
		15.3	+ 0.03
17.3	+ 0.14	15.4	+ 0.04
17.5	+ 0.12	15.5	+ 0.05
17.8	+ 0.15	15.6	+ 0.05
18.6	+ 0.15	15.8	+ 0.06
		16.0	+ 0.07
		17.2	+ 0.13
		17.6	+ 0.13
		17.8	+ 0.14
		18.0	+ 0.15
		18.5	+ 0.15
Montreal, June 23.			
h.	s.	h.	s.
14.2	+ 0.13	14.2	+ 0.13
14.3	+ 0.13	14.5	+ 0.13
15.0	+ 0.13	15.0	+ 0.14
15.3	+ 0.15	15.5	+ 0.13
15.5	+ 0.13	16.0	+ 0.12
16.0	+ 0.12	17.0	+ 0.12
18.8	+ 0.12	18.0	+ 0.12
		19.0	+ 0.12
21.2	+ 0.17		
21.3	+ 0.19	21.2	+ 0.19
21.4	+ 0.21	21.5	+ 0.19
21.9	+ 0.17	22.0	+ 0.18
22.2	+ 0.19	22.5	+ 0.18
23.1	+ 0.20	23.0	+ 0.19
23.1	+ 0.17		

* New setting of the instrument for level.

Data from Observations at Cambridge.

	Name of Star.	δ	Time of transit over mean of wires.	$Bb-\kappa$	Right Ascension.	$(T+Bb-\kappa)-\alpha$	A	B	C
	June 1, 1883.		Assumed value of hourly rate of clock = + 0^s.023.					Circle East.	
			h. m. s.	s.	h. m. s.	s.			
κ	Draconis - - - -	+ 70.4	12 28 45.57	— .06	12 28 30.82	+ 14.69	— 1.40	+ 2.61	+ 2.99
δ	Virginis - - - -	+ 4.0	12 49 59.72	— .04	12 49 45.12	+ 14.56	+ 0.62	+ 0.79	+ 1.00
43	H. Cephei, L. C. -	+ 91.4	12 53 12.90	+ .36	12 52 59.61	+ 13 65	+ 10.35	— 8.09	— 13.13
ε	Virginis - - - -	+ 11.6	12 56 38.30	— .05	12 56 23.66	+ 14.59	+ 0.52	+ 0.89	+ 1.01
	June 1, 1883.							Circle West.	
43	Comæ - - - - -	+ 28.5	13 6 42.27	— .06	13 6 27.17	+ 15.04	+ 0.27	+ 1.10	+ 1.14
α	Virginis - - - -	— 10.5	13 19 19.59	— .05	13 19 4.67	+ 14.87	+ 0.81	+ 0.61	+ 1.62
	Groombridge 2001 -	+ 73.0	13 23 27.95	— .22	13 23 11.38	+ 16 35	— 1.74	+ 2 94	+ 3.42
17	H. Canum Venat. -	+ 37.8	13 29 52.01	— .12	13 29 36.69	+ 15.20	+ 0.10	+ 1.26	+ 1.27
	June 2, 1883.		Assumed value of hourly rate of clock = + 0^s.022.					Circle West.	
ε	Ursae Majoris - -	+ 56.6	12 49 10.03	— .08	12 48 54.82	+ 15.13	— 0.44	+ 1.76	+ 1.82
ε	Virginis - - - -	+ 11.6	12 56 38.00	— .05	12 56 23.65	+ 14.30	+ 0.52	+ 0 89	+ 1.02
43	Comæ - - - - -	+ 28.5	13 6 41.48	+ .03	13 6 27.16	+ 14.35	+ 0.27	+ 1.10	+ 1.14
ζ	Hydræ - - - -	— 22.6	13 12 50.96	+ .01	13 12 36.90	+ 14.07	+ 0.98	+ 0.46	+ 1.08
η	Ursæ Majoris - -	+ 49.9	13 43 12.92	+ .10	13 42 58.18	+ 14.84	— 0.20	+ 1.54	+ 1.55
η	Bootis - - - - -	19 0	13 49 23 74	.06	13 49 9.47	14 33	0 42	0 97	1 06
50	Cassiopeiæ, L. C. -	— 108.2	13 53 41.75	— .06	13 53 29.34	+ 12.35	+ 2.93	— 1.32	— 3.21
	June 2, 1883.							Circle East.	
50	Cassiopeiæ, L. C. -	+ 108.2	13 53 42.82	— .06	13 53 29.34	+ 13.42	+ 2.93	— 1.32	— 3.21
α	Draconis - - - -	+ 64 9	14 1 30.02	+ .16	14 1 15.74	+ 14.44	— 0.90	+ 2.18	+ 2.36
κ	Virginis - - - -	— 9.7	14 6 56.05	+ .04	14 6 42.43	+ 13.66	+ 0.80	+ 0.62	+ 1.01
4	Ursæ Minoris - -	+ 78.1	14 9 37.08	— .11	14 9 22.03	+ 14.94	— 2.83	+ 3.94	+ 4.85
λ	Bootis - - - - -	+ 46.6	14 12 12.64	— .03	14 11 58.62	+ 13.99	— 0.11	+ 1.45	+ 1.46
ι	Cassiopeiæ, L. C. -	+ 113.1	14 19 41.24	+ .06	14 19 27.48	+ 13.82	+ 2.40	— 0.84	— 2.54
109	Virginis - - - -	+ 2.4	14 40 36.86	— .02	14 40 23.05	+ 13.79	+ 0.64	+ 0.78	+ 1.00
α^2	Libræ - - - - -	— 15.5	14 44 41.51	— .03	14 44 27.78	+ 13.70	+ 0.88	+ 0.55	+ 1.04*
	Groombridge 2164 -	+ 59.8	14 48 45.06	— .05	14 48 30.94	+ 14.07	— 0.59	+ 1.90	+ 1.99
48	H. Cephei - - -	+ 102.7	15 5 44.90	.00	15 5 31.69	+ 13.21	+ 3.95	— 2.25	— 4.55
β	Herculis - - - -	+ 21.8	16 25 28.39	— .09	16 25 14.39	+ 13.91	+ 0.38	+ 1.01	+ 1.08
A	Draconis - - - -	+ 69.0	16 28 30.92	— .22	16 28 16.03	+ 14.67	— 1.25	+ 2.50	+ 2.79
	Groombridge 848, L.C.	+ 104.3	16 33 19.70	+ .21	16 33 6.88	+ 13.03	+ 3.58	— 1.91	— 4.06
η	Herculis - - - -	+ 39.1	16 39 10.00	— .12	16 38 56.03	+ 13.85	+ 0.07	+ 1.29	+ 1.29
	Groombridge 2377 -	+ 57.0	16 43 22.05	— .19	16 43 7.74	+ 14.12	— 0.46	+ 1.79	+ 1.85
	June 2, 1883.							Circle West.	
α	Herculis - - - -	+ 14.5	17 8 36.21	— .14	17 8 21.85	+ 14.22	+ 0.49	+ 1.00	+ 1.04
β	Draconis - - - -	+ 52.4	17 27 5.34	— .01	17 26 50.35	+ 14.98	— 0.28	+ 1.62	+ 1.64
α	Ophiuchi - - - -	+ 12.6	17 28 47.66	— .01	17 28 33.32	+ 14.33	+ 0.52	+ 0.89	+ 1.03
	June 4, 1883.		Assumed value of hourly rate of clock = + 0^s.017.					Circle East.	
ε	Ursæ Majoris - -	+ 56.6	12 49 7.99	+ .02	12 48 54.77	+ 13.24	— 0.44	+ 1.76	+ 1.82
ε	Virginis - - - -	+ 11.6	12 56 36 33	.00	12 56 23.64	+ 12.69	+ 0.52	+ 0.89	+ 1.02
43	Comæ - - - - -	+ 28.5	13 6 40.05	.00	13 6 27.13	+ 12.92	+ 0.27	+ 1.10	+ 1.14
γ	Hydræ - - - - -	— 22.6	13 12 49.13	.00	13 12 36.89	+ 12.24	+ 0.98	+ 0.46	+ 1.08
α	Virginis - - - -	— 10.5	13 19 17.01	— .01	13 19 4.65	+ 12.35	+ 0.81	+ 0.61	+ 1.02
	Groombridge 2001 -	+ 73.0	13 23 25.28	— .06	13 23 11.17	+ 14.05	— 1.74	+ 2.94	+ 3.42
40	Cassiopeiæ, L. C. -	+ 107.5	13 29 24.68	+ .05	13 29 12.95	+ 11.78	+ 3.01	— 1.39	— 3.32
η	Ursæ Majoris - -	+ 49.9	13 43 11.26	— .02	13 42 58.14	+ 13.10	— 0.20	+ 1.54	+ 1.55
η	Bootis - - - - -	+ 19.0	13 49 22.16	— .03	13 49 9.45	+ 12.68	+ 0.42	+ 0.97	+ 1.02
50	Cassiopeiæ, L. C. -	+ 108.1	13 53 40.94	+ .04	13 53 29.48	+ 11.50	+ 2.93	— 1.32	— 3.21
α	Draconis - - - -	+ 64.9	14 1 29.21	— .06	14 1 15.69	+ 13.46	— 0.90	+ 2.18	+ 2.36

Data from Observations at Cambridge.

Name of Star.	δ	Time of transit over mean of wires.	$Bb-\kappa$	Right Ascension.	$(T+Bb-\kappa)-\alpha$	A	B	C
June 4, 1883.		Assumed value of hourly rate of clock = + 0^s.017.					circle west.	
	°	h. m. s.	s.	h. m. s.	s.			
α Draconis	+ 64.9	14 1 30.66	— .06	14 01 15.68	+ 14.92	— 0.90	+ 2.18	+ 2.36
κ Virginis	— 9.7	14 6 55.48	— .02	14 6 42.43	+ 13.03	+ 0.80	+ 0.62	+ 1.01
4 Ursæ Minoris	+ 78.1	14 9 39.44	— .11	14 9 21.88	+ 17.45	— 2.83	+ 3.94	+ 4.85
λ Bootis	+ 46.6	14 12 12.59	— .03	14 11 58.60	+ 13.96	— 0.11	+ 1.45	+ 1.46
ι Cassiopeiæ, L. C.	+ 113.1	14 19 38.58	+ .05	14 19 27.83	+ 10.80	+ 2.40	— 0.84	— 2.54
109 Virginis	+ 2.5	14 40 36.19	— .02	14 40 23.05	+ 13.12	+ 0.64	+ 0.78	+ 1.00
α^2 Libræ	— 15.5	14 44 40.53	— .02	14 44 27.78	+ 12.73	+ 0.88	+ 0.55	+ 1.04
Groombridge 2164	+ 59.8	14 48 45.39	— .03	14 48 30.91	+ 14.45	— 0.59	+ 1.90	+ 1.99
β Ursæ Minoris	+ 74.6	14 51 22.18	— .06	14 51 6.30	+ 15.82	— 2.01	+ 3.19	+ 3.77
ζ Ursæ Minoris	+ 78.2	15 48 36.35	+ .09	15 48 19.04	+ 17.40	— 2.85	+ 3.95	+ 4.87
δ Scorpii	— 22.3	15 53 41.53	.00	15 53 28.73	+ 12.80	+ 0.93	+ 0.46	+ 1.08
θ Draconis	+ 58.9	15 59 58.96	+ .04	15 59 44.71	+ 14.29	— 0.55	+ 1.86	+ 1.93
19 H. Ursæ Min.	+ 76.2	16 14 30.30	+ .07	16 14 13.87	+ 16.50	— 2.33	+ 3.48	+ 4.18
γ Herculis	+ 19.4	16 17 1.85	+ .02	16 16 48.54	+ 13.33	+ 0.41	+ 0.98	+ 1.06
June 4, 1883.							circle east.	
η Herculis	+ 39.2	16 39 9.00	+ .02	16 38 56.04	+ 12.98	+ 0.07	+ 1.29	+ 1.29
κ Ophiuchi	+ 9.5	16 52 23.50	+ .02	16 52 10.96	+ 12.56	+ 0.55	+ 0.85	+ 1.01
19 H. Camelop., L. C.	+ 100.9	17 3 28.02	+ .07	17 3 17.44	+ 10.65	+ 4.51	— 2.76	— 5.29
α Herculis	+ 14.5	17 9 34.57	— .04	17 9 21.86	+ 12.67	+ 0.48	+ 0.91	+ 1.03
June 5, 1883.		Assumed value of hourly rate of clock = + 0^s.013.					circle east.	
ε Ursæ Majoris	+ 56.6	12 49 7.76	— .10	12 48 54.75	+ 12.91	— 0.44	+ 1.76	+ 1.82
ε Virginis	+ 11.6	12 56 35.85	— .05	12 56 23.63	+ 12.17	+ 0.52	+ 0.88	+ 1.02
43 Comæ	+ 28.5	13 6 39.67	— .06	13 6 27.12	+ 12.49	+ 0.27	+ 1.10	+ 1.14
γ Hydræ	— 22.6	13 13 48.62	— .03	13 13 36.89	+ 11.70	+ 0.98	+ 0.46	+ 1.08
α Virginis	— 10.5	13 19 16.65	— .05	13 19 4.65	+ 11.95	+ 0.81	+ 0.61	+ 1.02
Groombridge 2001	+ 73.0	13 23 25.57	— .21	13 23 11.11	+ 14.25	— 1.74	+ 2.94	+ 3.42
40 Cassiopeiæ, L. C.	+ 107.5	13 29 23.17	+ .12	13 29 12.97	+ 10.32	+ 3.01	— 1.39	— 3.32
η Ursæ Majoris	+ 49.9	13 43 10.99	— .11	13 42 58.12	+ 12.76	— 0.20	+ 1.54	+ 1.55
η Bootis	+ 19.0	13 49 21.84	— .08	13 49 9.45	+ 12.31	+ 0.42	+ 0.97	+ 1.06
50 Cassiopeiæ L.C.	+ 108.1	13 53 39.62	+ .13	13 53 29.56	+ 10.19	+ 2.93	— 1.32	— 3.21
11 Bootis	+ 28.0	13 56 7.25	— .09	13 55 54.74	+ 12.42	+ 0.28	+ 1.09	+ 1.13
α Draconis	+ 64.9	14 1 29.42	— .17	14 1 15.65	+ 13.60	— 0.90	+ 2.18	+ 2.36
4 Ursæ Minoris	+ 78.1	14 9 37.32	— .27	14 9 21.82	+ 15.23	— 2.83	+ 3.94	+ 4.85
June 5, 1883.							circle west.	
4 Ursæ Minoris	+ 78.1	14 9 39.52	— .27	14 9 21.82	+ 17.43	— 2.83	+ 3.94	+ 4.85
ι Cassiopeiæ, L. C.	+ 113.1	14 19 37.48	+ .06	14 19 27.91	+ 9.63	+ 2.40	— 0.84	— 2.54
36 H. Cassiopeiæ, L. C.	+ 107.7	14 27 6.33	+ .01	14 26 57.46	+ 8.88	+ 2.99	— 1.37	— 3.29
Groombridge 2164	+ 59.8	14 48 45.04	+ .07	14 48 30.89	+ 14.22	— 0.59	+ 1.90	+ 1.99
β Ursæ Minoris	+ 74.5	14 50 22.86	+ .12	14 50 6.25	+ 16.73	— 2.01	+ 3.19	+ 3.77
ζ Ursæ Minoris	+ 78.1	15 48 36.56	+ .25	15 48 19.01	+ 17.80	— 2.85	+ 3.95	+ 4.87
δ Scorpii	— 22.3	15 53 40.97	+ .01	15 53 28.74	+ 12.24	+ 0.98	+ 0.46	+ 1.08
β Scorpii	— 19.5	15 58 53.98	+ .02	15 58 41.79	+ 12.21	+ 0.94	+ 0.50	+ 1.06
θ Draconis	+ 58.9	15 59 58.70	+ .12	15 59 44.70	+ 14.12	— 0.55	+ 1.86	+ 1.93
η Draconis	+ 61.8	16 22 41.97	+ .15	16 22 27.48	+ 14.64	— 0.70	+ 2.00	+ 2.12
β Herculis	+ 21.8	16 25 27.28	+ .07	16 25 14.42	+ 12.93	+ 0.38	+ 1.01	+ 1.08

Data from Observations at Montreal.

Name of Star.	δ	Time of transit over mean of wires.	Equivalent sidereal time.	$Bb—\kappa$.	Right Ascension.	$(T+Bb—\kappa)—\alpha$	A	B	C
June 17, 1883.		Assumed value of hourly rate of clock = $0^s.000$.						LAMP EAST.	
	°	h. m. s.	h. m. s.	s.	h. m. s.	s.			
β Coronæ - - - - - -	+ 29.5	9 38 57.70	15 22 56.72	— .20	15 23 3.10	— 6.58	+ 0.32	+ 1.10	+ 1.15
α Coronæ - - - - - -	+ 27.1	9 45 40.24	15 29 40.36	— .20	15 29 46.89	— 6.73	+ 0.36	+ 1.07	+ 1.12
α Serpentis - - - - -	+ 6.8	9 54 25.60	15 38 27.16	— .15	15 38 33.44	— 6.43	+ 0.63	+ 0.79	+ 1.01
β Serpentis - - - - -	+ 15.8	9 56 42.05	15 40 43.98	— .16	15 40 50.25	— 6.43	+ 0.52	+ 0.90	+ 1.04
κ Serpentis - - - - -	+ 18.5	9 59 22.68	15 43 25.05	— .17	15 43 31.39	— 6.51	+ 0.48	+ 0.94	+ 1.05
ζ Ursæ Minoris - - - -	+ 78.1	10 4 6.24	15 48 9.38	— .78	15 48 18.42	— 9.82	— 2.63	+ 4.10	+ 4.87
June 17, 1883.								LAMP WEST.	
β Scorpii - - - - - -	— 19.5	10 14 31.46	15 58 36.32	— .14	15 58 41.82	— 5.64	+ 0.96	+ 0.45	+ 1.06
δ Ophiuchi - - - - -	— 3.6	10 24 4.24	16 8 10.67	— .19	16 8 16.24	— 5.76	+ 0.77	+ 0.65	+ 1.00
ε Ophiuchi - - - - -	— 4.4	10 27 58.55	16 12 5.62	— .18	16 12 11.28	— 5.84	+ 0.77	+ 0.65	+ 1.00
19 Ursæ Minoris - - -	+ 76.2	10 30 0.30	16 14 7.70	—1.04	16 14 13.46	— 6.80	— 2.13	+ 3.60	+ 4.18
June 19, 1883.		Assumed value of hourly rate of clock = $0^s.000$.						LAMP EAST.	
α Draconis - - - - -	+ 64.9	8 9 30.15	14 1 7.58	+ .21	14 1 15.17	— 7.38	— 0.79	+ 2.23	+ 2.36
κ Virginis - - - - -	— 9.7	8 14 57.82	14 6 36.15	+ .04	14 6 42.33	— 6.14	+ 0.83	+ 0.58	+ 1.01
ι Cassiopeiæ, L. C.- - -	+ 113.1	8 27 44.02	14 19 24.06	— .07	14 19 28.65	— 4.66	+ 2.35	— 0.97	— 2.55
109 Virginis - - - - -	+ 2.5	8 48 32.88	14 40 16.72	+ .08	14 40 23.00	— 6.20	+ 0.68	+ 0.73	+ 1.00
Groombridge, 2164 - -	+ 59.8	8 56 37.98	14 48 23.15	+ .22	14 48 30.49	— 7.12	— 0.49	+ 1.93	+ 1.99
β Ursæ Minoris - - - -	+ 74.6	8 59 11.35	14 50 56.94	+ .37	14 51 5.53	— 8.22	— 1.84	+ 3.30	+ 3.77
48 H. Cephei, L. C. - - -	+ 102.7	9 13 42.03	15 5 30.01	— .27	15 5 33.01	— 3.27	+ 3.82	— 2.46	— 4.55
1 H. Ursæ Minoris- - -	+ 67.8	9 21 23.41	15 13 12.65	+ .33	15 13 20.27	— 7.29	— 1.00	+ 2.45	+ 2.64
β Coronæ - - - - - -	+ 29.5	9 31 5.63	15 22 56.46	+ .17	15 23 3.09	— 6.46	+ 0.32	+ 1.10	+ 1.15
α Coronæ - - - - - -	+ 27.1	9 37 48.34	15 29 40.28	+ .17	15 29 46.88	— 6.43	+ 0.36	+ 1.07	+ 1.12
June 20, 1883.		Assumed value of hourly rate of clock = $0^s.000$.						LAMP WEST.	
η Bootis - - - - - -	+ 19.0	7 53 31.67	13 49 3.04	+ .08	13 49 9.32	— 6.20	+ 0.47	+ 0.95	+ 1.06
α Draconis - - - - -	+ 64.9	8 5 34.73	14 1 8.08	+ .23	14 1 15.13	— 6.82	— 0.79	+ 2.23	+ 2.36
4 Ursæ Minoris - - - -	+ 78.1	8 13 37.31	14 9 11 97	+ .51	14 9 20.62	— 8.14	— 2.6[illegible]	+ 4.09	+ 4.85
ι Cassiopeiæ, L. C. - -	+ 113.1	8 23 47.63	14 19 23.97	— .11	14 19 28.91	— 5.05	+ 2.35	— 0.97	— 2.55
α Libræ - - - - - -	— 15.6	8 48 41.24	14 44 21.67	+ .08	14 44 27.73	— 5 98	+ 0.91	+ 0.50	+ 1.04
κ Serpentis - - - - -	+ 18.5	9 47 34.88	15 43 24 98	+ .16	15 43 31.38	— 6.24	+ 0.48	+ 0.94	+ 1.05
ζ Ursæ Min. - - - - -	+ 78.1	9 51 18.61	15 48 9.39	+ .71	15 48 18.24	— 8.14	— 2.63	+ 4.10	+ 4.87
γ Scorpii - - - - - -	— 22.3	9 57 31.01	15 53 22.75	+ .06	15 53 28.78	— 5.97	+ 1.00	+ 0.41	+ 1.08
β Scorpii - - - - - -	— 19.5	10 2 43.19	15 58 35.78	+ .06	15 58 41.81	— 5.97	+ 0.96	+ 0.45	+ 1.06
June 21, 1883.		Assumed value of hourly rate of clock = $0^s.000$.						LAMP EAST.	
α Libræ - - - - -	— 15.6	8 44 45.55	14 44 21.88	— .02	14 44 27.72	— 5.86	+ 0.91	+ 0.50	+ 1.04
β Ursæ Minoris- - - -	+ 74.6	8 51 20.63	14 50 58.05	+ .05	14 51 5.41	— 7.31	— 1.84	+ 3.30	+ 3.77
β Bootis - - - - - -	+ 40.8	8 57 49.82	14 57 28.30	— .01	14 57 34.81	— 6.55	+ 0.11	+ 1.32	+ 1.32
48 H. Cephei, L. C. - - -	+ 102.7	9 5 48.38	15 5 28.17	+ .02	15 5 33.18	— 4.99	+ 3.82	— 2.46	— 4.55
β Coronæ - - - - - -	+ 29.5	9 23 14.13	15 22 56.78	+ .02	15 23 3.07	— 6.27	+ 0.32	+ 1.10	+ 1.15
α Coronæ - - - - - -	+ 27.1	9 29 56.84	15 29 40.60	+ .03	15 29 46.86	— 6.23	+ 0.36	+ 1.07	+ 1.12
α Serpentis - - - - -	+ 6.8	9 38 42.15	15 38 27.35	+ .02	15 38 33.43	— 6.06	+ 0.63	+ 0.78	+ 1.01
β Serpentis - - - - -	+ 15.8	9 40 58.46	15 40 44.03	+ .03	15 40 50.24	— 6.18	+ 0.52	+ 0.90	+ 1.04
κ Serpentis - - - - -	+ 18.5	9 43 39.18	15 43 25.19	+ .04	15 43 31.38	— 6.15	+ 0.48	+ 0.94	+ 1.05
ζ Ursæ Minoris - - - -	+ 78.1	9 47 24.01	15 47 10.63	+ .17	15 47 18.18	— 7.38	— 2.63	+ 4.10	+ 4.87
δ Scorpii - - - - - -	— 22.3	9 53 35.08	15 53 22.72	+ .01	15 53 28.78	— 6.05	+ 1.00	+ 0.41	+ 1.08
β Scorpii - - - - - -	— 19.6	9 58 47.34	15 58 35.84	+ .01	15 58 41.82	— 5.97	+ 0.96	+ 0.45	+ 1.06

Data from Observations at Montreal.

Name of Star.	δ	Time of transit over mean of Wires.	Equivalent Sidereal Time.	$Bb-\kappa$	Right Ascension.	$(T+Bb-\kappa)-a$	A	B	C
June 21, 1883.		Assumed value of hourly rate of clock = $0^s.000$.						Lamp West.	
	°	h. m. s.	h. m. s.	s.	h. m. s.	s.			
19 H. Camelop., L. C. -	+ 100.9	11 3 15.08	17 3 14.17	— .36	17 3 18.18	— 4.37	+ 4.35	— 3.00	— 5.29
α Herculis - - - - -	+ 14.5	11 9 15.48	17 9 15 55	+ .10	17 9 21.99	— 6.34	+ 0.53	+ 0.89	+ 1.03
π Herculis - - - - -	+ 36.9	11 10 54.30	17 10 54.64	+ .14	17 11 1.36	— 6.58	+ 0.19	+ 1.24	+ 1.25
θ Ophiuchi - - - -	— 24.2	11 14 46.58	17 14 47.56	+ .03	17 14 53 52	— 5.93	+ 1.04	+ 0.27	+ 1.10
Groombridge, 966, L.C.	+ 105.0	11 23 58.75	17 24 1.24	— .20	17 24 5.84	— 4.80	+ 3.32	— 1.96	— 3.86
β Draconis - - - - -	+ 52.4	11 27 40.29	17 27 43.39	+ .18	17 27 50.44	— 6.87	— 0.20	+ 1.63	+ 1.64
μ Herculis - - - - -	+ 27.8	11 41 43.83	17 41 49.23	+ .13	17 41 55.95	— 6.59	+ 0.34	+ 1.08	+ 1.13
ψ^1 Draconis - - - - -	+ 72.2	11 43 51.17	17 43 56.93	+ .36	17 44 4 81	— 7.52	— 1.47	+ 2.92	+ 3.27
ξ Draconis - - - - -	+ 56.9	11 51 19.45	17 51 26.43	+ .24	17 51 33.69	— 7.02	— 0.35	+ 1.78	+ 1.82
γ Draconis - - - - -	+ 51.5	11 53 42.13	17 53 49.34	+ .21	17 53 56.50	— 6.95	— 0.17	+ 1.60	+ 1.61
γ Sagittarii - - - -	— 30.4	11 58 7.80	17 58 15.90	+ .02	17 58 21.80	— 5.88	+ 1.13	+ 0.28	+ 1.16
o Herculis - - - - -	+ 28.8	12 2 46.39	18 2 55.25	+ .14	18 3 1.91	— 6.52	+ 0.33	+ 1.09	+ 1.14
22 H. Camelop., L. C. -	+ 110.6	12 5 43.08	18 5 52.43	— .14	18 5 57.77	— 5.48	+ 2.57	— 1.19	— 2.84
δ Ursæ Minoris - - -	+ 86.6	12 9 50.00	18 10 0.03	+ 1.64	18 10 13.73	— 12.06	— 11.15	+ 12.64	+ 16.86
η Serpentis - - - - -	— 2.9	12 15 1.64	18 15 12.52	+ .09	18 15 18.85	— 6.24	+ 0.75	+ 0.67	+ 1.00
June 23, 1883.		Assumed value of hourly rate of clock = $+ 0^s.000$.						Lamp East.	
κ Virginis - - - - -	— 9.7	7 59 13.77	14 6 35.74	+ .07	14 6 42.20	— 6.49	+ 0.83	+ 0.58	+ 1.01
56 H. Cassiopeiæ, L. C.	+ 107.7	8 18 27.77	14 25 52.90	— .15	14 26 58.69	— 5.94	+ 2.91	— 1.53	— 3.29
109 Virginis - - - - -	+ 2.4	8 32 48.98	14 40 16.46	+ .09	14 40 22.98	— 6.43	+ 0.68	+ 0.73	+ 1.00
α Libræ - - - - - -	— 11.5	8 36 53.09	14 44 21.24	+ .04	14 44 27.72	— 6.44	+ 0.91	+ 0 50	+ 1.04
β Ursæ Minoris - - -	+ 74.6	8 43 28.74	14 50 57.97	+ .37	14 51 5.29	— 6 95	— 1 84	+ 3.30	+ 3.77
β Bootis - - - - - -	+ 40.9	8 49 57.32	14 57 27 62	+ .14	14 57 34.82	— 7 06	+ 0.11	+ 1.32	+ 1.32
48 H. Cephei, L. C. - -	+ 102.7	8 57 56.56	15 05 28 17	— .27	15 5 33.37	— 5.47	+ 3 82	— 2.46	— 4.55
γ Ursæ Minoris - - -	+ 72.3	9 13 16.04	15 20 50.17	+ .36	15 20 57.68	— 7.15	— 1.48	+ 2.93	+ 3.28
β Coronæ - - - - -	+ 29.5	9 15 21.74	15 22 56.25	+ .13	15 23 3 06	— 6.68	+ 0.32	+ 1.10	+ 1.15
ν^1 Bootis - - - - - -	+ 41.2	9 19 4.28	15 26 39.36	+ .17	15 26 46.24	— 6.71	+ 0.10	+ 1.33	+ 1 33
α Coronæ - - - - -	+ 27.1	9 22 4.38	15 29 39.95	+ .13	15 29 46.85	— 6.77	+ 0.36	+ 1.07	+ 1.12
α Serpentis - - - -	+ 6.8	9 30 49.92	15 38 26.93	+ .09	15 38 33.42	— 6.40	+ 0.63	+ 0 78	+ 1.01
β Serpentis - - - -	+ 15.8	9 33 6.32	15 40 43.70	+ .10	15 40 50.24	— 6.44	+ 0.52	+ 0.90	+ 1.04
κ Serpentis - - - -	+ 18.5	9 35 46.98	15 43 24.81	+ .10	15 43 31.37	— 6.46	+ 0.48	+ 0.94	+ 1.05
ζ Ursæ Minoris - - - -	+ 78.1	9 40 31.77	15 48 10.38	+ .46	15 48 18.05	— 7 21	— 2.63	+ 4.10	+ 4.87
δ Scorpii - - - - -	— 22.3	9 45 42.88	15 53 22.34	+ .03	15 53 28.78	— 6.41	+ 1.00	+ 0.41	+ 1.08
β Scorpii - - - - -	— 19.5	9 50 55.17	15 58 35.48	+ .04	15 58 41.82	— 6 30	+ 0.96	+ 0.45	+ 1.06
ξ Draconis - - - - -	+ 56.9	11 43 27.64	17 51 26.44	+ .17	17 51 33.69	— 7.08	— 0.36	+ 1.79	+ 1.83
γ Draconis - - - - -	+ 51.5	11 45 50.28	17 53 49.47	+ .16	17 53 56.50	— 6.87	— 0.17	+ 1.60	+ 1.61
109 Herculis - - - - -	+ 21.7	12 10 36.02	18 18 39.28	+ .10	18 18 46.01	— 6.63	+ 0.44	+ 1 00	+ 1.09
α Lyræ - - - - - -	+ 38.7	12 24 49.10	18 32 54.69	+ .13	18 33 1.85	— 7.03	+ 0.15	+ 1.27	+ 1.28
β Lyræ - - - - - -	+ 33.2	12 37 34.19	18 45 41.88	+ .12	18 45 48.85	— 6.85	+ 0.25	+ 1.17	+ 1.19
α Aquilæ - - - - -	+ 19.8	13 36 43.65	19 45 1.06	+ .09	19 45 7.81	— 6.66	+ 0.61	+ 0 81	+ 1.01

Data from Observations at Montreal.

Name of Star.	δ	Time of transit over mean of wires.	Equivalent sidereal time.	$Bb-\kappa$	Right Ascension.	$(T+Bb+\kappa)-\alpha$	A	B	C
June 23, 1883.			Assumed value of hourly rate of clock $=0^s.009$.					LAMP WEST.	
		h. m. s.	h. m. s.	s.	h. m. s.	s.			
α Cephei	+ 62°.1	15 7 10.87	21 15 43.14	+ .36	21 15 50.93	— 7.43	— 0.62	+ 2.05	+ 2.11
β Aquilæ	— 6.1	15 16 46.42	21 25 20.26	+ .11	21 25 27.02	— 6.65	+ 1.79	+ 0.63	+ 1.01
β Cephei	+ 70.1	15 18 31.05	21 27 5.18	+ .47	21 27 13.10	— 7.45	— 1.22	+ 2.67	+ 2.93
ξ Aquarii	— 8.4	15 22 52.82	21 31 27.66	+ .10	21 31 34.43	— 6.67	+ 0.82	+ 0 60	+ 1.01
11 Cephei	+ 70.8	15 31 32.13	21 40 8.40	+ .48	21 40 16.50	— 7.62	— 1.30	+ 2.74	+ 3.04
π^2 Cygni	+ 48.8	15 33 47.45	21 42 24.09	+ .27	21 42 31.58	— 7.22	— 0.09	+ 1.52	+ 1.52
μ Cephei	— 14.1	15 38 13.93	21 46 51.30	+ .08	21 46 57.97	— 6.59	+ 0.87	+ 0.52	+ 1.02
79 Draconis	+ 73.1	15 42 42.92	21 51 21.02	+ .53	21 51 29 13	— 7.58	— 1.60	+ 3.05	+ 3.45
α Aquarii	— 0.9	15 51 2.99	21 59 42.46	+ .11	21 59 49.33	— 6.76	+ 0.72	+ 0.69	+ 1.00
θ Aquarii	— 8.2	16 1 54.44	22 10 35.70	+ .09	22 10 42.40	— 6.61	+ 0.82	+ 0.60	+ 1.01
π Aquarii	+ 0.8	16 10 31.41	22 19 14.08	+ .12	22 19 20.88	— 6.68	+ 0.70	+ 0.71	+ 1.00
ζ Pegasi	+ 10.2	16 25 48.08	22 34 33.26	+ .14	22 34 40.35	— 6.95	+ 0.59	+ 0.83	+ 1.02
α Piscis austr.	— 30.2	16 42 19.13	22 51 7 03	+ .04	22 51 13.57	— 6.50	+ 1.12	+ 0.29	+ 1.16
α Pegasi	+ 14.6	16 50 2.60	22 58 51.76	+ .15	22 58 58.62	— 6.71	+ 0.53	+ 0.89	+ 1.03

Reduction of the Observations.

For the reduction of the observations, we have the following fundamental equation :

$$(1) \qquad 0=[T+\varkappa-\alpha]+Aa+Bb+Cc+\varDelta T.$$

in which :

$T=$ the observed time over the mean of the threads.

$\varkappa= \pm\ 0^s.0207 \cos\varphi \sec\delta$.

$\alpha=$ the assumed right ascension of the star observed.

$a=$ the azimuth constant.

$b=$ the level constant.

$c=$ the collimation constant.

$A=\sin(\varphi-\delta)\sec\delta=\sin z \sec\delta$.

$B=\cos(\varphi-\delta)\sec\delta=\cos z\sec\delta$.

$C=\sec\delta$.

$\varDelta T=$ the error of the clock at the instant of observation.

The constant b is always to be taken strictly as a mechanical constant, determined from the readings of the level. It may therefore be incorporated in the known term of the equation. We have therefore :

$$(2) \qquad 0=[T+\varkappa+Bb-\alpha]+Aa+Cc+\varDelta T.$$

It is always advisable to regard c also as a mechanical constant, if it can be obtained without the reversal of the instrument, or if it can be considered as a constant during the entire series of observations. If the instrument is provided with the two collimators, the value of c can be obtained as often as desired without reversal, and since the value of this constant can be found in this way with much greater precision than by any process which involves a reversal of the position of telescope, equation (1) can, in this case, take the form :

$$(3) \qquad 0=[(T+\varkappa+Bb+Cc)-\alpha]+Aa+\varDelta T.$$

in which only a and $\varDelta T$ remain to be determined.

Every star observed will give an equation of the forms (2) or (3), according to the method employed in the determination of the collimation. The conditions of this special problem are such, however, that the best determination of the unknown quantities involved will be had, when the stars observed are distributed in groups arranged in the following order with respect to the declination.

TIME STARS.	(1) Stars having a large south declination. (2) Stars situated near the equator. (3) Stars symmetrically distributed about the zenith of the observer.
POLAR STARS.	(1) Stars at the upper culmination. (2) Stars at the lower culmination.

Employing numerals to designate the time stars, primes to designate polar stars at the upper culmination, and seconds the polar stars at the lower culmination and writing

$$\Delta_0 = [(T + \varkappa + Bb) - \alpha]$$

we shall have a series of equations of the form:

$$(4)\quad \begin{cases} 1. & 0 = \Delta_0^1 + A_1 a + C_1 c + \Delta T. \\ 2. & 0 = \Delta_0^2 + A_2 a + C_2 c + \Delta T. \\ 3. & 0 = \Delta_0^3 + A_3 a + C_3 c + \Delta T. \\ 4. & 0 = \Delta_0^4 + A' a + C' c + \Delta T. \\ 5. & 0 = \Delta_0^5 + A'' a + C'' c + \Delta T. \end{cases}$$

The fact that the values of the unknown quantities derived from equations of form (4) are to a certain extent indeterminate must be recognized at the outset.

The degree of precision with which they can be determined will depend largely upon the proper distribution of the stars observed. If one does not inquire into the nature of the problem, there would seem to be no reason why a solution of a series of equations of the form given, by the process of least squares should not give the most probable value for each of the unknown quantities, but it is to be noted that the limited indeterminate character of the equations is inherent in the problem, and it can hardly be assumed that this indeterminateness will be removed by a least square solution.

If, however, the values of the constants a and c remain invariable throughout the entire series of observations, this method of discussion can be most advantageously employed, especially since by the change of sign in the co-efficient C, made necessary by the reversal of the instrument, the divisor, through which c is determined, becomes large. If, however, either a or c undergo a change in value at an *unknown* point of time during the observations, the values of the unknown quantities derived from a least square solution will be to a certain extent illusory, since the effect of the solution will be to distribute an error, which really occurs at one point, over the entire series, in such a way as to do the least harm.

If the change in the value of either a or c takes place during the operation of reversal, a solution of the entire series of equations under the supposition that a and c remain constant, will generally give residuals for the polar stars which have opposite signs for the two positions of the instrument.

If it is found to be necessary to determine the constants for each position of the instrument separately, the accuracy of the determination will, to a certain extent, depend upon the extent to which the conditions stated above are fulfilled, but some doubt must

always remain unless the value of c can be found as often as required by a mechanical process.

It is generally assumed that the value of c remains constant during the series of observations in one position of the instrument. Under this supposition, any change in the value of a can be detected by the derivation of this constant from time and polar stars having nearly the same right ascension compared with the value derived in a similar way at a later time in the series. On the supposition that the azimuth either varies uniformly or is constant for all the observations in one position of the instrument, and, after reversal takes another value which also varies uniformly, c being taken as a constant for the entire series, the equations will take the form:

$$(5) \quad \begin{cases} \text{For Lamp East.} & 0 = \delta\Delta_0 + A\delta a + 0.00\delta a' + C\delta c + \delta\Delta T. \\ \text{For Lamp West.} & 0 = \delta\Delta_0 + A\delta a' + 0.00\delta a - C\delta c + \delta\Delta T. \end{cases}$$

in which $\delta\Delta T$, δa, etc., represent the corrections to assumed approximate values of the unknown quantities.

If both a and c are considered as variables, the equations will take the form :

$$(6) \quad \begin{cases} \text{For Lamp East.} & 0 = \delta\Delta_0 + A\delta a + 0.00\delta a' + C\delta c + 0.00\delta c' + \delta\Delta T. \\ \text{For Lamp West.} & 0 = \delta\Delta_0 + A\delta a' + 0.00\delta a - C\delta c' + 0.00\delta c + \delta\Delta T. \end{cases}$$

It is doubtful, however, if there will ever be any real gain in increasing the number of the unknown quantities from three to five. In the Washington-Princeton series, δc is made equal to zero and the corrections, Aa, were applied throughout the groups before and after reversal by interpolating in a straight line between the two outside values of a. The equations then take the very simple form :

$$(7) \qquad 0 = \delta\Delta_0 + A\delta a + \delta\Delta T.$$

Thus far it has been assumed that all stars of a given series of observations have been observed with equal precision. Struve has shown [" Struve : Sur l'Emploi de l'Instrument des Passages," p. 17], that the relative precision of transit observations is a function of the secant of the declination of the star observed. The expression for the weight factor given by him is :

$$w = \sqrt{(0^s.072)^2 + \left(\frac{180}{n}\right)^2 (0^s.016)^2 \sec^2 \delta}.$$

where n = the magnifying power of the telescope compared with a standard power of 180.

For a power of 30, he found:

$$w = \sqrt{(0^s.072)^2 + (0^s.096)^2 \sec^2 \delta}.$$

These formulæ are also given in the " Recueil de Mémoires," p. 30.

Sawitch (" Praktischen Astronomie," p. 140) has given the more complete formula :

$$w = \sqrt{a^2 + \left(b^2 + \frac{n^2}{m^2} c^2 \right) \sec^2 \delta \sec^2 q}.$$

in which:

a = a constant dependent upon the sense of hearing, which for a given observer is constant for all stars.

b = a constant due to the unsteadiness of the stellar image arising from atmospheric disturbances. It is the same for all telescopes and is greatest near the horizon.

c = a constant dependent upon the sense of sight, and which varies therefore with the magnifying power.

n = the magnifying power of the telescope with which the constant c, considered as a standard of reference, has been determined.

m = the magnifying power of the telescope used.

q the parallactic angle.

Wagner ("Observations de Poulkowa," Vol. I., p. 85) has given for the magnifying power of 206, the equation

$$w = \sqrt{(0^s.067)^2 + (0^s.016)^2 \sec^2 \delta}.$$

And the general equation

$$w = \sqrt{(0^s.067)^2 + \left(\frac{2^s.06}{n}\right)^2 (0^s.016)^2 \sec^2 \delta}.$$

In the "Coast Survey Report for 1880," p. 36, there is given a determination of the relative weights which attach to the particular class of instruments described. The following useful table is transcribed from this volume.

Relative Weights.

δ	For large Portable Transit Instruments.	For small Portable Transit Instruments.
	w	w
0°	1.00	1.00
10	1.00	1.00
20	1.00	0.96
30	0.95	0.91
40	0.90	0.83
45	0.87	0.79
50	0.83	0.73
55	0.78	0.66
60	0.71	0.59
65	0.63	0.51
70	0.54	0.42
75	0.43	0.32
80	0.30	0.22
85	0.15	0.11
δ Ursæ Minoris. -	0.103	0.075
51 H. Cephei - - -	0.084	0.061
α Ursæ Minoris. -	0.041	0.030
λ Ursæ Minoris. -	0.033	0.024

Professor Safford has given (U.S. Surveys west of the 100th meridian, Vol. II, p. 346), the form

$$w \sec \delta = \sqrt{\frac{1.3}{\cos^2 \delta + 0.3}},$$

or

$$w = \sqrt{\frac{13}{10 + 3 \sec^2 \delta}}.$$

Struve's formula, reduced to this form, becomes :

$$w = \sqrt{\frac{13}{9 + 4 \sec^2 \delta}}.$$

Professor Young ("Washington Observations for 1875," p. 28) has properly introduced a factor which takes into account the effect of atmospheric disturbance depending upon the zenith distance of the star observed. The form given by him is :

$$w = \sqrt{\frac{12.35}{10 + 2 \sec z \sec^2 \delta}}.$$

The values of the weight-factor employed in the longitude operations between Washington and Princeton are supposed to belong to the Princeton instrument, but they were applied to the Washington observations as well.

In the present series of observations, there is no need of introducing the factor which depends on the number of threads observed, since, with a few exceptions, all the tallies were observed. The weight-factors were taken from the last formula given. The general equation (2) now becomes :

$$(8) \qquad 0 = w\,(\varDelta_0 + Aa + Cc + \varDelta T)$$

On account of the great labor involved in a complete solution by least squares, and especially because an error of observation at any point can only be detected after the complete solution has been effected, the writer has generally preferred, at least in a provisional solution, to deal with equations (4) in the following way. By subtracting the time equations from the polar equations, we have equations (9) as follows :

$$0 = \varDelta_0^1 - \varDelta_0^3 + (A_1 - A_3)\ a + (C_1 - C_3)\ c \qquad 0 = \varDelta_0^2 - \varDelta_0^4 + (A_2 - A')\ a + (C_2 - C')\ c$$
$$0 = \varDelta_0^2 - \varDelta_0^3 + (A_2 - A_3)\ a + (C_2 - C_3)\ c \qquad 0 = \varDelta_0^2 - \varDelta_0^5 + (A_2 - A'')\ a + (C_2 - C'')\ c$$

$$0 = \varDelta_0^1 - \varDelta_0^4 + (A_1 - A')\ a + (C_1 - C')\ c \qquad 0 = \varDelta_0^3 - \varDelta_0^4 + (A_3 - A')\ a + (C_3 - C')\ c$$
$$0 = \varDelta_0^1 - \varDelta_0^5 + (A_1 - A'')\ a + (C_1 - C'')\ c \qquad 0 = \varDelta_0^3 - \varDelta_0^5 + (A_3 - A'')\ a + (C_3 - C'')\ c$$

Dividing these equations by the co-efficients of c, we have equations (10) as follows :

$$[1] \quad 0 = \frac{\varDelta_0^1 - \varDelta_0^3}{C_1 - C_3} + \frac{A_1 - A_3}{C_1 - C_3}\,a + c \qquad [3] \quad 0 = \frac{\varDelta_0^1 - \varDelta_0^4}{C_1 - C'} + \frac{A_1 - A'}{C_1 - C'}\,a + c$$

$$[2] \quad 0 = \frac{\varDelta_0^2 - \varDelta_0^3}{C_2 - C_3} + \frac{A_2 - A_3}{C_2 - C_3}\,a + c \qquad [4] \quad 0 = \frac{\varDelta_0^1 - \varDelta_0^5}{C_1 - C''} + \frac{A_1 - A''}{C_1 - C''}\,a + c$$

$$[5]\quad 0=\frac{\Delta_0^2-\Delta_0^4}{C_2-C'}+\frac{A_2-A'}{C_2-C'}a+c \qquad [7]\quad 0=\frac{\Delta_0^3-\Delta_0^4}{C_3-C'}+\frac{A^3-A'}{C_3-C'}a+c$$

$$[6]\quad 0=\frac{\Delta_0^2-\Delta_0^5}{C_2-C''}+\frac{A_2-A''}{C_2-C''}a+c \qquad [8]\quad 0=\frac{\Delta_0^3-\Delta_0^5}{C_3-C''}+\frac{A_3-A''}{C_3-C''}a+c$$

Referring to equations (10), the values of a and c will be best determined from equations [4] and [3], if it can be assumed that there is no peculiar personal equation for stars observed at the lower culmination, and if these observations have approximately the same precision as corresponding observations at the upper culmination. For the remaining equations, the order of preference will be:

[6] .... [5]
[8] .... [7]
[1] .... [2]

Thus far we have considered the equations as referring to observations of single stars. If, however, the time stars are divided into groups in which each star observed has nearly the same declination, the mean of the several equations which compose a group may be taken as representing the passage of a fictitious star which has for its declination a value corresponding to the mean value of the azimuth. In this way considerable freedom from accidental errors may be obtained for the known terms of the equations.

If there are observations of several polar stars there will be a series of equations of the forms

[3], [4], [5], [6], [7], [8],

and the means of the separate groups of equations may be regarded as mean equations for the better determination of a and c.

It is to be noted that in the formation of unknown terms of equations (10), the clock is supposed to have a zero rate. If the hourly rate is appreciable, it must first be determined approximately and the observed times T must be reduced to an assumed common instant for each star. The advantages of the arrangement indicated above may be stated as follows:

(*a*) Without any previous knowledge of c, one can, with one or two substitutions of assumed values of c in equations (10) determine the value which will nearly satisfy all of the equations, since under perfect instrumental conditions and with perfect observations the value of a should be the same from each equation.

(*b*) While it cannot be expected that equations [1] and [2] of series (10) will yield very precise values of a and c, and while the direct solution is impossible; indirectly a very precise check upon the true value of c may be had by a comparison of the computed value of a for an assumed value of c with the corresponding values of a derived from the remaining equations.

(*c*) A check upon the assumed value of c will be had, first by a comparison of the separate values of a, and secondly by a comparison of the values of a for stars at opposite culminations.

(*d*) A bad observation can be easily detected by an inspection of the separate values of ΔT for the time groups and of a for the polar group.

It needs to be said, however, that these conclusions only hold when the following conditions are at least approximately fulfilled:

(a') When the observations are properly distributed in declination.

(b') When they are sufficiently good and sufficiently numerous to insure a substantial freedom from accidental errors.

(c') When there is a freedom from systematic errors in the system of fundamental stars employed.

(d') When the hourly rate of the clock is known.

(e') When allowance has been made for changes in the instrumental constants which occur during the observations.

(f') When the line of collimation of the telescope moves in an invariable plane.

(g') When the personal equation of the observer remains constant for stars at different declinations.

Conditions (f') and (g') relate to a particular instrument only, and to one observer with that instrument. It often happens that after an exhaustive discussion of the errors of a transit instrument in a given series of observations extending over a long period of time, different values of the azimuth constant are required for different zenith distances. It may be assumed, at least as a working hypothesis, that this result may be due to either one or both of the causes expressed under conditions (f') and (g'). No method has been tried which seems adequate to a proper discussion of the variation of the instrumental constants due to the deviation of the line of collimation from an invariable plane during the revolution of the telescope. If the residuals due to this cause are of the nature of systematic errors, they could probably be expressed by some empirical formula. At present this source of error must be considered as not proven. On the other hand, if these residuals are due to a variable personal equation on the part of the observer for stars at different declinations, it seems quite possible to determine the law of their formation. They can be expressed by a term Ee, added to the fundamental equation.

Equation (2) will then become

$$0 = \Delta_0 + Aa + Cc + \Delta T + Ee.$$

in which e must be determined by some mechanical method, and E may be assumed empirically, probably as some function of the secant of the zenith distance.

The value of e may be determined mechanically by observing transits of an artificial star at the focus of a collimator. In this way the two essential requirements of a personal equation machine would be fulfilled, since the observations would be made with the same instrument as that employed in the regular observations and the velocity of motion could be easily made equal to the apparent velocity of a star at any given declination.

Since both E and e are to be determined, e could not be obtained from a solution of the equations. Even if the form of the co-efficient E were known, it is doubtful if the solution would be sufficiently exact, on account of the probable slow change in the value of this co-efficient up to 60° or 70° north declination.

There are at least two independent sources of evidence that this variable personal equation really exists, and that it affects not only the determination of the instrumental constants, but the clock errors also.

In the meridian observations at Harvard College Observatory, the collimation is deter-

mined very frequently from the collimators. In the series of observations extending from 1870 to 1878, the value of Bessel's constant n was derived from equations of the following form, in which the nomenclature given above is followed :

$$0 = \Delta_0^1 + \tan \delta_1 \, n + (\Delta T + m)$$
$$0 = \Delta_0^2 + \tan \delta_2 \, n + (\Delta T + m)$$
$$0 = \Delta_0^3 + \tan \delta_3 \, n + (\Delta T + m)$$
$$0 = \Delta_0^4 + \tan \delta' \, n + (\Delta T + m)$$
$$0 = \Delta_0^5 + \tan \delta'' \, n + (\Delta T + m)$$

$$0 = \frac{\Delta_0^4 - \Delta_0^1}{\tan \delta' - \tan \delta_1} + n_1 \qquad 0 = \frac{\Delta_0^5 - \Delta_0^2}{\tan \delta'' - \tan \delta_2} + n_4$$

$$0 = \frac{\Delta_0^4 - \Delta_0^2}{\tan \delta' - \tan \delta_2} + n_2 \qquad 0 = \frac{\Delta_0^3 - \Delta_0^1}{\tan \delta_3 - \tan \delta_1} + n_5$$

$$0 = \frac{\Delta_0^5 - \Delta_0^1}{\tan \delta'' - \tan \delta_1} + n_3$$

$n =$ the value adopted for the evening of observation.

After the most careful discussion of the observed values of the collimation for each year, it was still found impossible to satisfy the relation :—

$$n = n_1 = n_2 = n_3 = n_4 = n_5$$

which should hold if every source of error was taken into account in the fundamental equation. These relations are given in the following table.

Year.	$n - n_1$	$n - n_2$	$n - n_3$	$n - n_4$	$n - n_5$	$n_1 - n_2$	$n_3 - n_4$	$n_3 - n_5$
	s.	s.	s.	s.	s.	s.	s.	s.
1871......	— .008	— .002	+ .015	+ .012	— .036	+ .006	— .003	— .051
1872......	— .003	.000	+ .006	+ .013	— .008	+ .003	— .003	— .013
1873......	+ .001	+ .008	— .002	— .004	— .005	+ .008	— .002	— .002
1874......	— .001	+ .010	— .006	— .014	— .016	+ .011	— .008	— .011
1875......	.000	+ .005	— .001	— .002	— .009	+ .006	— .001	— .004
1876......	+ .002	+ .007	— .002	— .006	— .017	+ .005	— .004	— .016
1877......	— .001	+ .006	— .003	— .004	— .025	+ .007	— .001	— .022
Means. ..	— .001	+ .005	+ .001	— .002	— .017	+ .007	— .003	— .017

It will be seen from this table that the value of the constant n, which satisfies the observations near the equator, fails to satisfy those situated near the zenith by an average amount of nearly $0^s.02$. Since this variation does not appear to be dependent either on the position of the instrument or upon the season of the year, it must probably be referred to the personality of the observer.

Secondly, during the past year, the writer undertook, in conjunction with Mr. S. C. Chandler, assistant at the Observatory, a series of simultaneous observations with the Meridian Circle, and with a new instrument invented by him and named "The Almucantar," for the purpose of testing a new form of level attached to the meridian circle, as well as for the purpose of making a direct comparison of the two instruments in the determination of absolute time. Another question of special importance to Mr. Chandler, and for which

his instrument offered peculiar facilities for investigation, was the examination of the law of the variation of the personal equation of the observer, due to the varying velocity and direction of the motion of the star with respect to the threads. His discussion of the material so far obtained has led to the conclusion, which he puts forward simply as a plausible inference, to be held tentatively for future investigation that the personal equation of the observer is a function of the velocity of the star in a direction perpendicular to the thread, and that this relation may be expressed by :

$$E = a\ (\sec \delta \sec p)^{k}$$

in which a is a constant and p is the position angle of the thread. The exponent k, in all the observations thus far examined, appears to be in the neighborhood of one-half, and corresponds to the provisional working hypothesis

$$E = a \sqrt{\sec \delta \sec p}.$$

The interpretation of this expression is that *the personal equation in transit observations varies inversely as the square root of the velocity of the star across the thread.* In the case of meridian observations $p = o$ and the relation becomes

$$E = a \sqrt{\sec \delta}.$$

It will not escape attention that there are evidences in the present series of observations, both at Cambridge and at Montreal, of systematic deviations between the values of the clock error depending upon the declination of the star observed. At Montreal, the illumination was not entirely symmetrical for different altitudes. At Cambridge, the source of error most likely to occur, was that due either to a variation in the collimation through a movement of the prism in the cube or to the flexure of the instrument. No decisive evidences of error from these causes have been found. It seems probable, therefore, that the discordances noted, may be in some way connected with the question of variable personal equation.

As an illustration of the method of reduction described on pp. 137-139, the observations of June 4 are selected. By subtracting the equations for the time stars of each group from the equations for the separate polar stars, and dividing by the co-efficient of c, we find :

	Time.	Group I.	Group II.	Group II.′	Group III.
	h.	s.	s.	s.	s.
CIRCLE EAST	13.4 *U.C.*	$0 = +0.74 - 1.11a + c$	$0 = +0.55 - .91a + c$	$0 = +0.55 - .91a + c$	$0 = +0.52 - .81a + c$
	13.4 *L.C.*	$- .12 + .48a - c$	$- .22 + .60a - c$	$- .23 + .60a - c$	$- .28 + .67a - c$
	13.9 *L.C.*	$- .19 + .48a - c$	$- .29 + .59a - c$	$- .30 + .59a - c$	$- .34 + .67a - c$
	17.0 *L.C.*	$- .25 + .57a - c$	$- .32 + .65a - c$	$- .32 + .65a - c$	$- .36 + .70a - c$
CIRCLE WEST	14.2 *U.C.*	$0 = +1.20 - .98a - c$	$0 = +1.10 - .88a - c$	....	$0 = +1.04 - .78a - c$
	14.9 *U.C.*	$+1.09 - 1.06a - c$	$+ .95 - .92a - c$	....	$+ .78 - .80a - c$
	15.8 *U.C.*	$+1.19 - .98a - c$	$+1.09 - .88a - c$	....	$+1.03 - .79a - c$
	16.2 *U.C.*	$+1.17 - 1.03a - c$	$+1.04 - .90a - c$	....	$+ .95 - .80a - c$
	14.3 *L.C.*	$- .58 + .42a + c$	$- .68 + .53a + c$	....	$- .81 + .66a + c$

From the means of the equations for stars of the same culmination we have, after combining the corresponding equations in Groups II and II,′ Circle East, and neglecting weights :

Circle East, *U.C.*	(1)	$0 = + .74 - 1.11a + c$	$0 = + .55 - .91a + c$	$0 = + .52 - .81a + c$
L.C.	(2)	$0 = - .19 + .51a - c$	$0 = - .28 + .61a - c$	$0 = - .33 + .68a - c$
Circle West, *U.C.*	(3)	$0 = + 1.16 - 1.01a - c$	$0 = + 1.04 - .89a - c$	$0 = + .95 - .79a - c$
L.C.	(4)	$0 = - .58 + .42a + c$	$0 = - .68 + .53a + c$	$0 = - .81 + .66a + c$

From the combination of :

	I.		II.		III.	
(1) and (2),	$a = +$ 0.92 s.	$c = +$ 0.28 s.	$a = +$ 0.90 s.	$c = +$ 0.27 s.	$a =$	$c =$ ......
(3) and (4),	+ .98	+ .17	+ 1.00	+ .15	......	......
(1) and (3),	+ .90	+ .25	+ .88	+ .25	+ 0.92 s.	+ 0.23 s.
(1) and (4),	+ .86	+ .22	+ .85	+ .23	+ .90	+ .21
(2) and (3),	+ .89	+ .26	+ .85	+ .24	+ .87	+ .26
(2) and (4),	+ .83	+ .28	+ .84	+ .23	+ .85	+ .25

Since there is no decisive evidence of a change in the value of the constants during the reversal, it is better to choose the values derived from the combination of the equations for opposite positions of the telescope. Combining the last four values in each group we have :

From Group I. - - - - - - - - - - - - - - - - - -	$a = +$ 0.87 s.	$c = +$ 0.25 s.
From Group II. - - - - - - - - - - - - - - - - -	$a = +$ .86	$c = +$ .24
From Group III. - - - - - - - - - - - - - - - -	$a = +$ .88	$c = +$ .24

It will be instructive to compare the values of a for different values of c in the different groups. Assuming $c = + .10, + .25$ and $+ .40$, we have :

Time.		Group I.			Group II.			Group II′.			Group III.		
	h.	FOR $c = +.10$	+.25	+ .40	$c = +.10$	+.25	+ .40	$c = +.10$	+.25	+ .40	$c = +.10$	+.25	+ .40
Circle East.	13.4	$a = +.76$	+.89	+1.03	$a = +.71$	+.88	+1.04	$a = +.71$	+.88	+1.04	$a = +.77$	+.95	+1.13
	13.4	+.46	+.77	+1.08	+.53	+.78	+1.03	+.55	+.80	+1.05	+.57	+.79	+1.02
	13.9	+.60	+.92	+1.23	+.66	+.92	+1.17	+.66	+.93	+1.19	+.66	+.88	+1.10
	17.0	+.61	+.88	+1.14	+.65	+.88	+1.11	+.65	+.88	+1.11	+.66	+.87	+1.09
	Means.	+.61	+.87	+1.12	+.64	+.87	+1.09	+.65	+.87	+1.10	+.66	+.87	+1.09
Circle West.	14.2	$a = +1.12$	+.97	+.82	$a = +1.14$	+.96	+.79	- - - - - - - - -			$a = +1.20$	+1.01	+.82
	14.9	+ .93	+.79	+.65	+ .94	+.78	+.60	- - - - - - - - -			+ .85	+ .66	+.48
	15.8	+1.11	+.96	+.81	+1.03	+.95	+.78	- - - - - - - - -			+1.18	+ .99	+.80
	16.2	+1.04	+.89	+.75	+1.04	+.88	+.71	- - - - - - - - -			+1.06	+ .88	+.69
	14.3	+1.14	+.79	+.43	+1.09	+.81	+.53	- - - - - - - - -			+1.08	+ .85	+.62
	Means.	+1.07	+.88	+.69	+1.05	+.88	+.68				+1.07	+ .88	+.68

The time equations for this date are :

Group.	δ	For Circle East.	δ	For Circle West.
	°	s.	°	s.
I.	— 16.0	$0 = + 12.28 + 0.90a + 1.05c + \Delta T$	— 19.2	$0 = + 12.86 + 0.89a - 1.04c + \Delta T$
II.	+ 19.7	$0 = + 12.74 + 0.40a + 1.06c + \Delta T$	+ 11.0	$0 = + 13.24 + 0.52a - 1.03c + \Delta T$
III.	+ 57.1	$0 = + 13.25 - 0.51a + 1.91c + \Delta T$	+ 57.6	$0 = + 14.40 - 0.54a - 1.93c + \Delta T$

Substituting $c = + 0^s.25$ and $a = + 0^s.87$ in these equations we have, neglecting weights :

For Circle East.

	s.
From Group I.	$\Delta T = + 13.29$
From Group II.	$\Delta T = + 13.35$
From Group III.	$\Delta T = + 13.28$

For Circle West.

	s.
From Group I.	$\Delta T = + 13.37$
From Group II.	$\Delta T = + 13.43$
From Group III.	$\Delta T = + 13.45$

and the mean value $\Delta T = + 13^s.362$.

In a solution by the process of least squares, that value of ΔT must be used, which results from the solution of the normal equations, but when the solution is made in the form illustrated by this example, it is proper to obtain the value of ΔT by the combination of only those stars in which the effect of an error in the azimuth is the most completely eliminated. Stars having a large south declination were observed solely for the better determination of the instrumental constants. Having served this purpose, their further use may properly be dispensed with.

Making the combination indicated, we have :

For Circle East.

Time.	δ	ΔT
h.	°	s.
12.9	+ 11.6	+ 13.37
13.1	+ 28.5	+ 13.41
13.8	+ 19.0	+ 13.29
16.6	+ 39.1	+ 13.39
16.9	+ 9.5	+ 13.33
17.1	+ 14.5	+ 13.39
12.8	+ 56.6	+ 13.28
13.7	+ 49.9	+ 13.29
14.0	+ 64.9	+ 13.26

For Circle West.

Time.	δ	ΔT
h.	°	s.
14.7	+ 2.5	+ 13.43
16.3	+ 19.4	+ 13.45
14.0	+ 64.9	+ 13.54
14.2	+ 46.6	+ 13.49
14.8	+ 59.8	+ 13.44
16.0	+ 58.9	+ 13.35

The mean value of ΔT for the entire series is $+ 13^s.381$.

Subtracting equations I and II from equation III, on page 35, and dividing by the co-efficient of c, we have :

For Circle East.

$$0 = + 1^s.13 - 1.64a + c$$
$$0 = + 0.60 - 1.07a + c$$

For Circle West.

$$0 = + 1^s.73 - 1.61a - c$$
$$0 = + 1.29 - 1.18a - c$$

From which with the value of $c = + 0^s.25$, we obtain :

$$a = + 0^s.84 \qquad\qquad a = + 0^s.92$$
$$a = + 0.80 \qquad\qquad a = + 0.88$$

It will be seen that, while these equations are not suitable for the determination of a and c, they form an excellent check upon the derived value of a, with an assumed value of c.

On the following pages will be found the equation for each star observed, arranged in the order of declination. The values of $\Delta_0 = [(T + Bb - k) - \alpha]$ have been reduced to the time given by means of the adopted hourly rate. The means for each group are printed in antique type.

On the right hand side of the page will be found, the computed value of $- \Delta T$ for each star with the values of a and c given. These values result from the least square solution between a and c. The residuals given in antique type are found by comparing the adopted mean value of $- \Delta T$ with the mean value for each group of time stars, and for each separate polar star. In those cases, in which the unknown quantities have been derived from the equations for each position of the telescope separately, the residuals are given on the extreme right.

EQUATIONS BETWEEN ΔT, a, AND c, FROM OBSERVATIONS AT CAMBRIDGE.

Group.	T.	δ.	Equations of Condition. $(T+Bb-\kappa)-\alpha$.	Aa.	Cc.	ΔT.	ΔT.	Residuals.	
June 1, 1883.				CIRCLE EAST.		At 13.1 h.		s. c = + 0.20, a = + 0.38, −ΔT = + 14.97	
	h.	°	s.				s.		
I	12.8	+ 4.0	0 = +14.55	+ 0.62a	+ 1.00c	+1.00ΔT	+14.99		
	12.9	+ 11.6	+14.59	+ 0.52a	+ 1.01c	+1.00ΔT	+14.99	s.	
		+ *7.8*	*+14.57*	*+ 0.57a*	*+ 1.01c*	+1.00ΔT	*+14.99*	*+0.02*	
Polar Stars	12.4	+ 70.4	0 = +14.67	− 1.40a	+ 2.99c	+1.00ΔT	+14.74	*−0.23*	
	12.9	+ 94.4	+13.65	+10.35a	−13.13c	+1.00ΔT	+14.95	*−0.02*	
June 1, 1883.				CIRCLE WEST.		At 13.1 h.			
	h.	°	s.				s.	s	
I	13.3	− 10.5	0 = +14.87	+0.81a	−1.02c	+1.00ΔT	+14.98	*+0.01*	
II	13.1	+ 28.5	0 = +15 04	+0.27a	−1.14c	+1.00ΔT	+14.91		
	13.5	+ 37.8	+15.21	+0.10a	−1.27c	+1.00ΔT	+14.99		
		+ *33.2*	*+15.12*	*+0.18a*	*−1.20c*	+1.00ΔT	*+14.95*	*−0.02*	
Polar Star	13.3	+ 73.0	0 = +16.35	−1.74a	−3.42c	+1.00ΔT	+15.01	*+0.04*	
June 2, 1883.				CIRCLE WEST.		At 14.9 h.		s. c = − 0.176, a = + 0.507, −ΔT = +14.325	s. c = − 0.189, a = + 0 456, −ΔT = +14.345
	h.	°	s.				s.	s.	s.
I	13.2	− 22.6	0 = +14.03	+0.98a	+1.08c	+1.00ΔT	+14.34	*+0.015*	*−0.065*
II	12.9	+ 11.6	0 = +14.26	+0.52a	+1.02c	+1.00ΔT	+14.34		
	13.1	+ 28.5	+14.31	+0.27a	+1.14c	+1.00ΔT	+14.25		
	13.8	+ 19.0	+14.31	+0.42a	+1.06c	+1.00ΔT	+14.33		
		+ *19.7*	*+14.29*	*+0.40a*	*+1.07c*	+1.00ΔT	*+14.307*	*−0.018*	*−0.072*
III	12.8	+ 56.6	0 = +15.08	−0.44a	+1.82c	+1.00ΔT	+14.54		
	13.7	+ 49.9	+14.81	−0.20a	+1.55c	+1.00ΔT	+14.44		
		+ *53.2*	*+14.74*	*−0.32a*	*+1.68c*	+1.00ΔT	*+14.490*	*+0.165*	*+0.140*
Polar Star	13.9	+108.2	0 = +12.33	+2.93a	−3 21c	+1.00ΔT	+14.37	*+0.045*	*−0.065*
				CIRCLE EAST.		At 14.9 h.			s. c = − 0.284, a = + 0.673, −ΔT = +14.410
	h.	°	s.				s.		
I	14.1	− 9.7	0 = +13.64	+0.80a	−1.01c	+1.00ΔT	+14.23		
	14.7	+ 2.4	+13.79	+0.64a	−1.00c	+1.00ΔT	+14.29		
	14.7	− 15.5	+13.70	+0.88a	−1.04c	+1.00ΔT	+14.33	s.	s.
		− *7.6*	*+13.71*	*+0.77a*	*−1.02c*	+1.00ΔT	*+14.283*	*−0.042*	*+0.110*
III	14.2	+ 46.6	0 = +13.97	−0.11a	−1.46c	+1.00ΔT	+14.17		
	14.4	+ 59.8	+14.06	−0.59a	−1.99c	+1.00ΔT	+14.11		
		+ *53.2*	*+14.02*	*−0 35a*	*−1.72c*	+1.00ΔT	*+14.140*	*−0.185*	*−0.145*

EQUATIONS BETWEEN ΔT, a, AND c, FROM OBSERVATIONS AT CAMBRIDGE.—*Continued.*

Group.	T.	δ.	Equations of Condition.					ΔT.	Residuals.	
				(T+Bb−κ)−α.	Aa.	Cc.	ΔT.			
June 2, 1883.					Circle East.		At 14.9 h.			
	h.	°		s.				s.		
II′	16.4	+ 21.7	0 =	+13.94	+0.38a	−1.08c	+1.00ΔT	+14.32		
	16.6	+ 39.1		+13.89	+0.07a	−1.29c	+1.00ΔT	+14.16	s.	s.
		+ 30.4		*+13.92*	*+0.22a*	*−1.18c*	+1.00ΔT	*+14.240*	*−0.085*	*+0.000*
III′	16.7	+ 57.0	0 =	+14.16	−0.40a	−1.85c	+1.00ΔT	+14.25	*−0.075*	*−0.040*
Polar Stars	13.9	+108.2	0 =	+13.40	+2.93a	+3.21c	+1.00ΔT	+14.32	*−0.005*	*+0.050*
	14.0	+ 64.9		+14.42	−0.90a	−2.36c	+1.00ΔT	+14.38	*+0.055*	*+0.070*
	14.2	+ 78.1		+14.92	−2.83a	−4.85c	+1.00ΔT	+14.34	*+0.015*	*−0.010*
	14.3	+113.1		+13.81	+2.40a	+2.54c	+1.00ΔT	+14.58	*+0.255*	*+0.300*
	15.1	+102.7		+13.21	+3.95a	+4.55c	+1.00ΔT	+14.41	*+0.085*	*+0.170*
	16.5	+ 69.0		+14.70	−1.25a	−2.79c	+1.00ΔT	+14.56	*+0.235*	*+0.240*
	16.5	+109.3		+13.06	+3.58a	+4.06c	+1.00ΔT	+14.17	*−0.155*	*−0.090*
					Circle West.		At 14.9 h.			
	h.	°		s.				s.		
I	17.1	+ 14.5	0 =	+14.27	+0.49a	+1.04c	+1.00ΔT	+14.34		
	17.5	+ 52.4		+15.04	−0.28a	+1.64c	+1.00ΔT	+14.61		
	17.5	+ 12.6		+14.39	+0.52a	+1.03c	+1.00ΔT	+14.47	s.	
		+ 26.5		*+14.57*	*+0.24a*	*+1.24c*	+1.00ΔT	*+14.473*	*+1.28*	
June 4, 1883.					Circle East.		At 14.6 h.		s. c = + 0.26 a = + 0.89 −ΔT = +13.375	
	h.	°		s.				s.		
I	13.2	− 22.6	0 =	+12.22	+0.98a	+1.08c	+1.00ΔT	+13.37		
	13.3	− 10.5		+12.33	+0.81a	+1.02c	+1.00ΔT	+13.32	s.	
		− 16.5		*+12.28*	*+0.90a*	*+1.05c*	+1.00ΔT	*+13.350*	*−0.025*	
II	12.9	+ 11.6	0 =	+12.66	+0.52a	+1.02c	+1.00ΔT	+13.39		
	13.1	+ 28.5		+12.89	+0.27a	+1.14c	+1.00ΔT	+13.43		
	13.8	+ 19.0		+12.67	+0.42a	+1.02c	+1.00ΔT	+13.31		
		+ 19.7		*+12.74*	*+0.40a*	*+1.06c*	+1.00ΔT	*+13.377*	*+0.002*	
III	12.8	+ 56.6	0 =	+13.21	−0.44a	+1.82c	+1.00ΔT	+13.29		
	13.7	+ 49.9		+13.08	−0.20a	+1.55c	+1.00ΔT	+13.30		
	14.0	+ 64.9		+13.45	−0.90a	+2.36c	+1.00ΔT	+13.26		
		+ 57.1		*+13.25*	*−0.51a*	*+1.91c*	+1.00ΔT	*+13.283*	*−0.092*	
II′	16.6	+ 39.1	0 =	+13.01	+0.07a	+1.29c	+1.00ΔT	+13.41		
	16.9	+ 9.5		+12.60	+0.55a	+1.01c	+1.00ΔT	+13.35		
	17.1	+ 14.5		+12.71	+0.48a	+1.03c	+1.00ΔT	+13.41		
		+ 21.0		*+12.77*	*+0.37a*	*+1.11c*	+1.00ΔT	*+13.390*	*+0.015*	
Polar Stars	13.4	+ 73.0	0 =	+14.03	−1.74a	+3.42c	+1.00ΔT	+13.37	*−0.005*	
	13.4	+107.5		+11.76	+3.01a	−3.32c	+1.00ΔT	+13.33	*−0.045*	
	13.9	+108.1		+11.49	+2.93a	−3.21c	+1.00ΔT	+13.27	*−0.105*	
	17.0	+100.9		+10.69	+4.51a	−5.29c	+1.00ΔT	+13.32	*−0.055*	

EQUATIONS BETWEEN ΔT, a, AND c, FROM OBSERVATIONS AT CAMBRIDGE.—*Continued.*

Group.	T.	δ.	Equations of Condition. $(T+Bb-\kappa)-\alpha$.	Aa.	Cc.	ΔT.	ΔT.	Residuals.	
			CIRCLE WEST.			At 14.6 h.			
	h.	°	s.				s.		
I	14.1	− 9.7	0 = +13.02	+0.80a	−1.01c	+1.00ΔT	+13.47		
	14.7	− 15.5	+12.73	+0.88a	−1.04c	+1.00ΔT	+13.24		
	15.9	− 22.3	+12.82	+0.98a	−1.08c	+1.00ΔT	+13.41	s.	
		− 19.2	*+12.83*	*+0.89a*	*−1.04c*	+1.00ΔT	*+13.373*	*−0.002*	
II	14.7	+ 2.5	0 = +13.12	+0.64a	−1.00c	+1.00ΔT	+13.42		
	16.3	+ 19.4	+13.36	+0.41a	−1.06c	+1.00ΔT	+13.44		
		+ 11.0	*+13.24*	*+0.52a*	*−1.03c*	+1.00ΔT	*+13.430*	*+0.055*	
III	14.0	+ 64.9	0 = +14.91	−0.90a	−2.36c	+1.00ΔT	+13.50		
	14.2	+ 46.6	+13.95	−0.11a	−1.46c	+1.00ΔT	+13.47		
	14.8	+ 59.8	+14.45	−0.59a	−1.90c	+1.00ΔT	+13.40		
	16.0	+ 58.9	+14.31	−0.55a	−1.93c	+1.00ΔT	+13.32		
		+ 57.6	*+14.40*	*−0.54a*	*−1.93c*	+1.00ΔT	*+13.422*	*+0.047*	
Polar Stars	14.2	+ 78.1	0 = +17.44	−2.83a	−4.85c	+1.00ΔT	+13.66	*+0.285*	
	14.3	+113.1	+10.80	+2.40a	+2.54c	+1.00ΔT	+13.46	*+0.085*	
	14.9	+ 74.6	+15.83	−2.01a	−3.77c	+1.00ΔT	+13.05	*−0.325*	
	15.8	+ 78.2	+17.42	2.85a	−4.87c	+1.00ΔT	+13.61	*+0.235*	
	16.2	+ 76.2	+16.53	−2.33a	−4.18c	+1.00ΔT	+13.37	*−0.065*	
June 5, 1883.			CIRCLE EAST.			At 14.4 h.		s. $c=+0.24$ $a=+1.20$ $-\Delta T=+13.059$	s. $c=+0.16$ $a=+1.09$ $-\Delta T=+12.876$
	h.	°	s.				s.		
I	13.2	− 22.6	0 = +11.68	+0.98a	+1.08c	+1.00ΔT	+13.11		
	13.3	− 10.5	+11.94	+0.81a	+1.02c	+1.00ΔT	+13.15	s.	s.
		− 16.6	*+11.81*	*+0.90a*	*+1.05c*	+1.00ΔT	*+13.130*	*+0.071*	*+0.074*
II	12.9	+ 11.6	0 = +12.15	+0.52a	+1.02c	+1.00ΔT	+13.01		
	13.1	+ 28.5	+12.47	+0.27a	+1.14c	+1.00ΔT	+13.07		
	13.8	+ 19.0	+12.30	+0.42a	+1.06c	+1.00ΔT	+13.05		
	13.9	+ 28.0	+12.41	+0.28a	+1.13c	+1.00ΔT	+13.02		
		+ 21.8	*+12.33*	*+0.37a*	*+1.09c*	+1.00ΔT	*+13.038*	*−0.021*	*+0.036*
III	12.8	+ 56.6	0 = +12.89	−0.44a	+1.82c	+1.00ΔT	+12.81		
	13.7	+ 49.9	+12.75	−0.20a	+1.55c	+1.00ΔT	+12.88		
	14.0	+ 64.9	+13.60	−0.90a	+2.36c	+1.00ΔT	+13.09		
		+ 57.1	*+13.08*	*−0.51a*	*+1.91c*	+1.00ΔT	*+12.927*	*−0.132*	*−0.049*
Polar Stars	13.4	+ 73.0	0 = +14.24	−1.74a	+3.42c	+1.00ΔT	+12.98	*−0.079*	*+0.014*
	13.4	+107.5	+10.31	+3.01a	−3.32c	+1.00ΔT	+13.11	*+0.051*	*+0.184*
	13.9	+108.1	+10.18	+2.93a	−3.21c	+1.00ΔT	+12.92	*−0.139*	*−0.036*
	14.1	+ 78.1	+15.23	−2.83a	+4.85c	+1.00ΔT	+13.00	*−0.059*	*+0.054*
			CIRCLE WEST.			At 14.4 h.			s. $c=+0.05$ $a=+1.46$ $-\Delta T=+13.370$
	h.	°	s.				s.		
I	15.9	− 22.3	0 = +12.26	+0.98a	−1.08c	+1.00ΔT	+13.17		
	16.0	− 19.5	+12.23	+0.94a	−1.06c	+1.00ΔT	+13.11	s.	s.
		− 20.9	*+12.24*	*+0.96a*	*−1.07c*	+1.00ΔT	*+13.140*	*+0.081*	*+.0225*

EQUATIONS BETWEEN ΔT, a, AND c, FROM OBSERVATIONS AT CAMBRIDGE.—*Continued.*

Group.	T.	δ.	Equations of Condition. $(T+Bb-\kappa)-\alpha$.	Aa.	Cc.	ΔT.	ΔT.	Residuals.	
June 5, 1883.				CIRCLE WEST.		At 14.4 h.			
	h.	°	s.				s.	s.	s.
II	16.4	+ 21.8	0 = +12.95	+0.38a	−1.08c	+1.00ΔT	+13.15	*+0.091*	*+0.080*
III	14.8	+ 59.8	0 = +14.22	−0.59a	−1.99c	+1.00ΔT	+13.04		
	16.0	+ 58.9	+14.14	−0.55a	−1.93c	+1.00ΔT	+13.03		
	16.4	+ 61.8	+14.66	−0.70a	−2.12c	+1.00ΔT	+13.21		
		+ 60.2	*+14.34*	*−0.61a*	*−2.01c*		*+13.093*	*+0.034*	*+0.027*
Polar Stars	14.2	+ 78.1	0 = +17.43	−2.83a	−4.85c	+1.00ΔT	+12.88	*−0.179*	*−0.310*
	14.3	+113.1	+ 9.63	+2.40a	+2.54c	+1.00ΔT	+13.12	*+0.061*	*−0.110*
	14.4	+107.7	+ 8.88	+2.99a	+3.29c	+1.00ΔT	+13.26	*+0.201*	*+0.050*
	14.8	+ 74.5	+16.73	−2.01a	−3.77c	+1.00ΔT	+13.42	*+0.361*	*+0.240*
	15.8	+ 78.1	+17.82	−2.85a	−4.87c	+1.00ΔT	+13.23	*+0.171*	*+0.050*

EQUATIONS BETWEEN ΔT, a, AND c, FROM OBSERVATIONS AT MONTREAL.

Group.	T.	δ.	Equations of Condition. $(T+Bb-\kappa)-\alpha$.	Aa.	Cc.	ΔT.	ΔT.	Residuals.	
June 17, 1883.				LAMP EAST.		At 15.8 h.		s. $c = +0.31$ $a = -0.68$ $-\Delta T = -6.560$	
	h.	°	s.				s.		
I	15.4	+ 29.5	0 = − 6.58	+0.32a	+1.15c	+1.00ΔT	− 6.44		
	15.5	+ 27.1	− 6.73	+0.36a	+1.12c	+1.00ΔT	− 6.62		
	15.6	+ 6.8	− 6.43	+0.63a	+1.01c	+1.00ΔT	− 6.55		
	15.7	+ 15.8	− 6.43	+0.52a	+1.04c	+1.00ΔT	− 6.46		
	15.7	+ 18.5	− 6.51	+0.48a	+1.05c	+1.00ΔT	− 6.52	s.	
		+ 19.5	*− 6.54*	*+0.46a*	*+1.07c*		*− 6.518*	*+0.042*	
Polar Star	15.8	+ 78.1	0 = − 9.82	−2.63a	+4.87c	+1.00ΔT	− 6.52	*+0.040*	
				LAMP WEST.		At 15.8 h.			
	h.	°	s.				s.		
I	16.0	− 19.5	0 = − 5.64	+0.96a	−1.06c	+1.00ΔT	− 6.62		
	16.1	− 3.6	− 5.76	+0.77a	−1.00c	+1.00ΔT	− 6.59		
	16.2	− 4.4	− 5.84	+0.77a	−1.00c	+1.00ΔT	− 6.67	s.	
		− 9.2	*− 5.75*	*+0.83a*	*−1.02c*		*− 6.627*	*−0.067*	
Polar Star	16.2	+ 76.2	0 = − 6.80	−2.13a	−4.18c	+1.00ΔT	− 6.65	*−0.090*	
June 19, 1883.				LAMP EAST.		At 14.9 h.		s. $c = +0.15$ $a = -0.65$ $-\Delta T = -6.500$	
	h.	°	s.				s.		
I	14.0	− 9.7	0 = − 6.14	+0.83a	+1.01c	+1.00ΔT	− 6.53		
	14.7	+ 2.5	− 6.20	+0.68a	+1.00c	+1.00ΔT	− 6.49	s.	
		− 3.6	*− 6.17*	*+.675a*	*+1.00c*	+1.00ΔT	*− 6.510*	*−0.010*	

Equations between ΔT, a, and c, from Observations at Montreal.—*Continued*

Group.	T.	δ.	Equations of Condition. $(T+Bb-\kappa)-\alpha$.	Aa.	Cc.	ΔT.	ΔT.	Residuals.	
June 9, 1883.				Lamp East.		At $14^{h}.9$.			
	h.	°	s.				s.		
II	15.4	+ 29.5	0 = − 6.46	+0.32a	+1.15c	+1.00ΔT	− 6.50		
	15.5	+ 27.1	− 6.43	+0.36a	+1.12c	+1.00ΔT	− 6.49	s.	
		+ 28.3	*− 6.45*	*+0.34a*	*+1.13c*		*− 6.495*	*+0.005*	
III	14.8	+ 59.8	0 = − 7.12	−0.49a	+1.99c	+1.00ΔT	− 6.50	*+0.000*	
Polar Stars	14.0	+ 64.9	0 = − 7.38	−0.79a	+2.36c	+1.00ΔT	− 6.52	*−0.020*	
	14.3	+113.1	− 4.66	+2.35a	−2.55c	+1.00ΔT	− 6.57	*−0.070*	
	14.8	+ 74.6	− 8.22	−1.84a	+3.77c	+1.00ΔT	− 6.46	*+0.040*	
	15.1	+102.7	− 3.27	+3.82a	−4.55c	+1.00ΔT	− 6.43	*+0.070*	
	15.2	+ 67.8	− 7.57	−1.00a	+2.64c	+1.00ΔT	− 6.54	*−0.040*	
June 20, 1883.				Lamp West.		At $15^{h}.2$.		s. $c = +0.05$ $a = -0.54$ $-\Delta T = -6.405$	
	h.	°	s.				s.		
I	14.7	− 15.6	0 = − 5.98	+0.91a	+1.04c	+1.00ΔT	− 6.41		
	15.9	− 22.3	− 5.97	+1.00a	+1.08c	+1.00ΔT	− 6.46		
	16.0	− 19.5	− 5.97	+0.96a	+1.06c	+1.00ΔT	− 6.44	s.	
		− 19.1	*− 5.97*	*+0.96a*	*+1.06c*		*− 6.437*	*−0.032*	
II	13.8	+ 19.0	0 = − 6.20	+0.47a	+1.06c	+1.00ΔT	− 6.40		
	15.7	+ 18.5	− 6.24	+0.48a	+1.05c	+1.00ΔT	− 6.45		
		+ 18.8	*− 6.22*	*+0.48a*	*+1.05c*		*− 6.425*	*−0.020*	
III	14.1	+ 64.9	0 = − 6.82	−0.79a	+2.36c	+1.00ΔT	− 6.27	*+0.135*	
Polar Stars	14.1	+ 78.1	0 = − 8.14	−2.61a	+4.85c	+7.00ΔT	− 6.49	*−0.085*	
	14.3	+113.1	− 5.05	+2.35a	−2.55c	+1.00ΔT	− 6.45	*−0.045*	
	15.8	+ 78.1	− 8.14	−2.63a	+4.87c	+1.00ΔT	− 6.48	*−0.075*	
June 21, 1883.				Lamp East.		At $16^{h}.6$.		s. $c = -0.04$ $a = -0.45$ $-\Delta T = -6.570$	s. $c = -0.137$ $a = -0.581$ $-\Delta T = -6.638$
	h.	°	s.				s.		
I	14.7	− 15.6	0 = − 5.86	+0.91a	+1.04c	+1.00ΔT	− 6.31		
	15.9	− 22.3	− 6.05	+1.00a	+1.08c	+1.00ΔT	− 6.55		
	16.0	− 19.7	− 5.97	+0.96a	+1.06c	+1.00ΔT	− 6.44	s.	s.
		− 19.2	*− 5.96*	*+0.96a*	*+1.06c*		*− 6.433*	*+0.137*	*−0.022*
II	15.0	+ 40.8	0 = − 6.55	+0.11a	+1.32c	+1.00ΔT	− 6.65		
	15.4	+ 29.5	− 6.27	+0.32a	+1.15c	+1.00ΔT	− 6.46		
	15.5	+ 27.1	− 6.23	+0.36a	+1.12c	+1.00ΔT	− 6.43		
	15.6	+ 6.8	− 6.06	+0.63a	+1.01c	+1.00ΔT	− 6.38		
	15.7	+ 15.8	− 6.18	+0.52a	+1.04c	+1.00ΔT	− 6.45		
	15.7	+ 18.5	− 6.15	+0.48a	+1.05c	+1.00ΔT	− 6.41		
		+ 23.1	*− 6.24*	*+0.40a*	*+1.12c*		*− 6.463*	*+0.107*	*+0.011*
Polar Stars	14.9	+ 74.6	0 = − 7.31	−1.84a	+3.77c	+1.00ΔT	− 6.63	*−0.060*	*−0.122*
	15.1	+102.7	− 4.99	+3.82a	−4.55c	+1.00ΔT	− 6.53	*+0.040*	*+0.048*
	15.8	+ 78.1	− 7.38	−2.63a	+4.87c	+1.00ΔT	− 6.38	*+0.190*	*+0.118*

EQUATIONS BETWEEN ΔT, a, AND c, FROM OBSERVATIONS AT MONTREAL.— *Continued.*

Group.	T.	δ.		Equations of Condition. $(T+Bb-\kappa)-\alpha$.	Aa.	Cc.	ΔT.	ΔT.	Residuals.	
June 21, 1883.					LAMP WEST.		At 16.6 h.			s. $c=+0.000$ $a=-0.496$ $-\Delta T=-6\ 670$
	h.	°		s.				s.		
I	17.2	− 24.2	0 =	− 5.93	+ 1.04a	− 1.10c	+1.00ΔT	− 6.36		
	18.0	− 30.4		− 5.88	+ 1.13a	− 1.16c	+1.00ΔT	− 6.35		
	18.3	− 2.9		− 6.24	+ 0.75a	− 1.00c	+1.00ΔT	− 6.54	s.	s.
		− 19.2		*− 6.02*	*+ 0.97a*	*− 1.09c*		*− 6.417*	*+0.153*	*+0.170*
II	17.2	+ 14.5	0 =	− 6.34	+ 0.53a	− 1.03c	+1.00ΔT	− 6.54		
	17.7	+ 27.8		− 6.59	+ 0.34a	− 1.13c	+1.00ΔT	− 6.70		
	18.0	+ 28.8		− 6.52	+ 0.33a	− 1.14c	+1.00ΔT	− 6.63		
		+ 23.7		*− 6.48*	*+ 0.40a*	*− 1.10c*		*− 6.623*	*−0.053*	*−0.010*
III	17.2	+ 36.9	0 =	− 6.58	+ 0.19a	− 1.25c	+1.00ΔT	− 6.62		
	17.4	+ 52 4		− 6.87	− 0.20a	− 1.64c	+1.00ΔT	− 6.72		
	17.8	+ 56.9		− 7.02	− 0.35a	− 1.82c	+1.00ΔT	− 6.79		
	17.9	+ 51.5		− 6.95	− 0.17a	− 1.61c	+1.00ΔT	− 6.81		
		+ 49.4		*− 6.85*	*− 0.13a*	*− 1.58c*		*− 6.735*	*−0.165*	*−0.120*
Polar Stars	17.1	+100.9	0 =	− 4.37	+ 4.35a	+ 5.29c	+1.00ΔT	− 6.54	*+0.030*	*+0.140*
	17.4	+105.0		− 4.80	+ 3.32a	+ 3.86c	+1.00ΔT	− 6.44	*+0.130*	*+0.220*
	17.7	+ 72.2		− 7.52	− 1.47a	− 3.27c	+1.00ΔT	− 6.73	*−0.160*	*−0.120*
	18.2	+ 86.6		−12.06	−11.15a	−16.86c	+1.00ΔT	− 6.37	*+0.200*	*+0.140*
	18.5	+110.6		− 5.48	+ 2.57a	+ 2 84c	+1.00ΔT	− 6.75	*−0.180*	*−0.081*
June 23, 1883.					LAMP EAST.		At 19.2 h.		s. $c=-0.06$ $a=-0.34$ $-\Delta T=-6.886$	
	h.	°		s.				s.		
I	14.1	− 9.7	0 =	− 6.53	+0.83a	+1.01c	+1.00ΔT	− 6.87		
	14.7	+ 2.4		− 6.47	+0.68a	+1.00c	+1.00ΔT	− 6.76		
	14.7	− 11.5		− 6.48	+0.91a	+1.04c	+1.00ΔT	− 6 85		
	15.9	− 22.3		− 6.44	+1.00a	+1.08c	+1.00ΔT	− 6.84		
	16.0	− 19.5		− 6.33	+0.96a	+1.06c	+1.00ΔT	− 6.72	s.	
		− 12.1		*− 6.45*	*+0.88a*	*+1.04c*	+1.00ΔT	*− 6.808*	*+0.078*	
II	15.4	+ 29.5	0 =	− 6.71	+0.32a	+1.15c	+1.00ΔT	− 6.89		
	15.5	+ 27.1		− 6.80	+0.36a	+1.12c	+1.00ΔT	− 6.99		
	15.6	+ 6.8		− 6.43	+0.63a	+1.01c	+1.00ΔT	− 6.70		
	15.7	+ 15.8		− 6.47	+0.52a	+1.04c	+1.00ΔT	− 6.71		
	15.7	+ 18.5		− 6.49	+0.48a	+1.05c	+1.00ΔT	− 6.71		
	18.3	+ 21.7		− 6.64	+0.44a	+1.09c	+1.00ΔT	− 6.85		
	19.8	+ 8.6		− 6.66	+0.61a	+1.01c	+1.00ΔT	− 6.93		
		+ 18.3		*− 6.60*	*+0.48a*	*+1.07c*	+1.00ΔT	*− 6.826*	*+0.060*	
III	14.9	+ 40.9	0 =	− 7.10	+0.11a	+1.32c	+1.00ΔT	− 7.22		
	15.4	+ 41.2		− 6.74	+0.10a	+1.33c	+1.00ΔT	− 6.85		
	17.9	+ 56.9		− 7.09	−0.36a	+1.83c	+1.00ΔT	− 7.05		
	17.9	+ 51.5		− 6.88	−0.17a	+1.61c	+1.00ΔT	− 6.92		
	18.5	+ 38.7		− 7.04	+0.15a	+1.28c	+1.00ΔT	− 7.17		
	18.7	+ 33.2		− 6.85	+0.25a	+1.19c	+1.00ΔT	− 7.00		
		+ 43.7		*− 6.95*	*+0.01a*	*+1.43c*		*− 7.035*	*−0.149*	

EQUATIONS BETWEEN ΔT, a, AND c, FROM OBSERVATIONS AT MONTREAL.—*Continued.*

Group.	T.	δ.	Equations of Condition.				ΔT.	Residuals.
			$(T+Bb-\kappa)-\alpha$.	Aa.	Cc.	ΔT.		
June 23, 1883.				Lamp East.		At $19^h.2$		
	$h.$	$\circ$	$s.$				$s.$	$s.$
Polar Stars	14.4	+107.7	0 = − 5.98	+2.91a	−3.29c	+1.00ΔT	− 6.77	*+0.116*
	14.8	+ 74.6	− 6.99	−1.84a	+3.77c	+1.00ΔT	− 0.59	*+0.296*
	15.1	+102.7	− 5.51	+3.82a	−4.55c	+1.00ΔT	− 6.54	*+0.346*
	15.3	+ 72.3	− 7.18	−1.48a	+3.28c	+1.00ΔT	− 6.88	*+0.006*
	15.8	+ 78.1	− 7.24	−2.63a	+4.87c	+1.00ΔT	− 6.64	*+0.246*
				Lamp West.		At $19^h.2$		
	$h.$	$\circ$	$s.$				$s.$	
I	21.4	− 6.1	0 = − 6.63	+0.79a	−1.01c	+1.00ΔT	− 6.84	
	21.5	− 8.4	− 6.65	+0.82a	−1.01c	+1.00ΔT	− 6.87	
	21.8	− 14.1	− 6.57	+0.87a	−1.02c	+1.00ΔT	− 6.81	
	22.0	− 0.9	− 6.74	+0.72a	−1.00c	+1.00ΔT	− 6.92	
	22.2	− 8.2	− 6.58	+0.82a	−1.01c	+1.00ΔT	− 6.80	
	22.3	+ 0.8	− 6.65	+0.70a	−1.00c	+1.00ΔT	− 6.83	
	22.9	− 30.2	− 6.47	+1.12a	−1.16c	+1.00ΔT	− 6.78	$s.$
		− 9.6	*− 6.61*	*+0.83a*	*−1.03c*		*− 6.836*	*+0.050*
II	21.7	+ 48.8	0 = − 7.20	−0.09a	−1.52c	+1.00ΔT	− 7.08	
	22.6	+ 10.2	− 6.92	+0.59a	−1.02c	+1.00ΔT	− 7.06	
	23.0	+ 14.6	− 6.68	+0.53a	−1.03c	+1.00ΔT	− 6.80	
		+ 24.5	*− 6.93*	*+0.34a*	*−1.19c*		*− 6.980*	*−0.094*
Polar Stars	21.3	+ 62.1	0 = − 7.41	−0.62a	−2.14c	+1.00ΔT	− 7.07	*−0.184*
	21.5	+ 70.1	− 7.43	−1.22a	−2.93c	+1.00ΔT	− 6.85	*+0.036*
	21.7	+ 70.8	− 7.60	−1.30a	−3.04c	+1.00ΔT	− 6.94	*−0.054*
	21.9	+ 73.1	− 7.56	−1.60a	−3.45c	+1.00ΔT	− 6.81	*+0.076*

The equations which follow, are derived by subtracting each mean equation for the time stars from each of the equations for the polar stars.

In the solution by least squares, only the normal equations are given. In the exact solution of the two equations involving two unknown quantities, the final equation involving either a or c is given, since the sine of the last divisor is an index of the degree of precision which may be expected from the solution.

COMBINATION OF MEAN EQUATIONS FROM *TIME GROUPS* WITH THE SEPARATE EQUATIONS OF THE *POLAR GROUP*. EQUATIONS BETWEEN a AND c. FROM OBSERVATIONS AT CAMBRIDGE.

JUNE 1, 1883.

FUNDAMENTAL EQUATIONS.

Circle East.

$$\begin{array}{rcrrr} 0 & = & \overset{s.}{+0.09} & -1.97a & +1.98c \\ & = & -0.93 & +9.78a & -14.14c \end{array}$$

Circle West.

$$\begin{array}{rcrrr} 0 & = & \overset{s.}{+1.48} & -2.55a & -2.40c \\ & = & +1.23 & -1.92a & -2.22c \end{array}$$

NORMAL EQUATIONS.

From Circle East and Circle West.

$$\begin{array}{rcrrr} 0 & = & \overset{s.}{-15.40} & +109.71a & -131.81c \\ 0 & = & +7.05 & -131.81a & +214.55c \end{array}$$

$$0 = \overset{s.}{-0.87} \quad -0.428c$$

Hence, $c = \overset{s.}{+0.203}$

$a = +0.384$

JUNE 2, 1883.

FUNDAMENTAL EQUATIONS.

Circle East.

$$\begin{array}{rcrrr} 0 & = & \overset{s.}{-0.31} & +2.16a & +4.23c \\ & = & +0.71 & -1.67a & -1.34c \\ & = & +1.21 & -3.60a & -3.83c \\ & = & +0.10 & +1.63a & +3.56c \\ & = & -0.50 & +3.18a & +5.57c \\ & = & +0.99 & -2.02a & -1.77c \\ & = & -0.65 & +2.81a & +5.08c \end{array}$$

Circle West.

$$\begin{array}{rcrrr} 0 & = & \overset{s.}{-1.70} & +1.95a & -4.29c \\ 0 & = & -1.96 & +2.53a & -4.28c \end{array}$$

NORMAL EQUATIONS.

From Circle West and Circle East.

$$\begin{array}{rcrrr} 0 & = & \overset{s.}{-19.75} & +55.36a & +47.32c \\ 0 & = & +1.32 & +47.32a & +143.71c \end{array}$$

$$0 = \overset{s.}{-0.385} \quad -2.182c$$

Hence, $c = \overset{s.}{-0.176}$

$a = +0.507$

From Circle West.

$$\begin{array}{rcrrr} 0 & = & \overset{s.}{-1.70} & +1.95a & -4.29c \\ 0 & = & -1.96 & +2.53a & -4.28c \end{array}$$

$$0 = \overset{s.}{-0.0620} \quad +0.136a$$

Hence, $c = \overset{s.}{-0.189}$

$a = +0.456$

From Circle East.

$$\begin{array}{rcrrr} 0 & = & \overset{s.}{-11.48} & +45.16a & +66.52c \\ 0 & = & -14.36 & +66.52a & +106.99c \end{array}$$

$$0 = \overset{s}{+0.0383} \quad +0.135c$$

Hence, $c = \overset{s.}{-0.284}$

$a = +0.673$

JUNE 4, 1883.

FUNDAMENTAL EQUATIONS.

Circle East.

$$\begin{array}{rcrrr} 0 & = & \overset{s.}{+1.75} & -2.64a & +2.37c \\ & = & -0.52 & +2.11a & -4.37c \\ & = & -0.79 & +2.03a & -4.26c \\ & = & -1.59 & +3.61a & -6.34c \\ & = & +1.99 & -2.14a & +2.36c \\ & = & -0.98 & +2.61a & -4.38c \\ & = & -1.25 & +2.53a & -4.27c \\ & = & -2.05 & +4.11a & -6.35c \\ & = & +1.28 & -2.11a & +2.31c \\ & = & -1.01 & +2.64a & -4.43c \\ & = & -1.28 & +2.56a & -4.32c \\ & = & -2.08 & +4.14a & -6.40c \end{array}$$

Circle West.

$$\begin{array}{rcrrr} 0 & = & \overset{s.}{+4.58} & -3.72a & -3.81c \\ & = & -2.06 & +1.51a & +3.58c \\ & = & +2.97 & -2.90a & -2.73c \\ & = & +4.56 & -3.74a & -3.83c \\ & = & +3.67 & -3.22a & -3.14c \\ & = & +4.20 & -3.35a & -3.82c \\ & = & -2.44 & +1.88a & +3.57c \\ & = & +2.59 & -2.53a & -2.74c \\ & = & +4.18 & -3.37a & -3.84c \\ & = & +3.29 & -2.85a & -3.15c \end{array}$$

NORMAL EQUATIONS.

From Circle East and Circle West.

$$\begin{array}{rcrrr} 0 & = & \overset{s.}{-153.96} & +188.06a & -53.93c \\ 0 & = & -47.69 & -53.93a & +371.31c \end{array}$$

$$0 = \overset{s.}{-1.703} \quad +6.603c$$

Hence, $c = \overset{s.}{+0.258}$

$a = +0.89$

JUNE 5, 1883.

FUNDAMENTAL EQUATIONS.

Circle East.

$$\begin{array}{rcrrr} 0 & = & \overset{s.}{+2.43} & -2.64a & +2.37c \\ & = & -1.50 & +2.11a & -4.37c \\ & = & -1.63 & +2.03a & -4.26c \\ & = & +3.42 & -3.73a & +3.80c \\ & = & +1.91 & -2.11a & +2.33c \\ & = & -2.02 & +2.64a & -4.41c \\ & = & -2.15 & +2.56a & -4.30c \\ & = & +2.90 & -3.20a & +3.76c \end{array}$$

Circle West.

$$\begin{array}{rcrrr} 0 & = & \overset{s.}{+5.19} & -3.79a & -3.78c \\ & = & -2.61 & +1.44a & +3.61c \\ & = & -3.36 & +2.03a & +4.36c \\ & = & +4.49 & -2.97a & -2.70c \\ & = & +5.58 & -3.81a & -3.80c \\ & = & +4.48 & -3.21a & -3.77c \\ & = & -3.32 & +2.02a & +3.62c \\ & = & -4.07 & +2.61a & +4.37c \\ & = & +3.78 & -2.39a & -2.69c \\ & = & +4.87 & -3.23a & -3.79c \end{array}$$

NORMAL EQUATIONS.

From Circle East and Circle West.

$$\begin{array}{rcrrr} 0 & = & \overset{s.}{-171.11} & +138.88a & +22.47c \\ 0 & = & -86.57 & +22.47a & +250.89c \end{array}$$

$$0 = \overset{s.}{+2.621} \quad -11.004c$$

Hence, $c = \overset{s.}{+0.238}$

$a = +1.20$

From Circle East.

$$\begin{array}{rcrrr} 0 & = & \overset{s.}{-49.80} & +57.66a & -77.90c \\ 0 & = & +65.76 & -77.90a & +114.82c \end{array}$$

$$0 = \overset{s.}{-0.020} \quad +0.122c$$

Hence, $c = \overset{s.}{+0.164}$

$a = +1.086$

From Circle West.

$$\begin{array}{rcrrr} 0 & = & \overset{s.}{-121.30} & +81.22a & +100.37c \\ 0 & = & -152.33 & +100.37a & +136.07c \end{array}$$

$$0 = \overset{s.}{-0.025} \quad +0.549c$$

Hence, $c = \overset{s.}{+0.045}$

$a = +1.458$

COMBINATION OF MEAN EQUATIONS FROM *TIME GROUPS* WITH THE SEPARATE EQUATIONS OF THE *POLAR GROUP*. EQUATIONS BETWEEN a AND c. FROM OBSERVATIONS AT MONTREAL.

JUNE 17, 1883.

FUNDAMENTAL EQUATIONS.

Lamp East.

$$0 = \overset{s.}{-3.28} \quad -3.09a \quad +3.80c$$

Lamp West.

$$0 = \overset{s.}{-1.05} \quad -2.96a \quad -3.16c$$

NORMAL EQUATIONS.

From Lamp East and Lamp West.

$$\begin{array}{lllll} 0 & = & \overset{s.}{+13.25} & +18.31a & -\ 2.3[illegible]c \\ 0 & = & -\ 9.14 & -\ 2.39a & +24.42c \end{array}$$

$$0 = \overset{s.}{-3.0881} \quad +10.0871c$$

$$\text{Hence,}\quad c = \overset{s.}{+0.306}$$
$$a = -0.684$$

JUNE 19, 1883.

FUNDAMENTAL EQUATIONS.

Lamp East.

$$\begin{array}{lllll} 0 & = & \overset{s.}{-1.21} & -1.54a & +1.36c \\ & = & +1.51 & +1.60a & -3.55c \\ & = & -2.05 & -2.59a & +2.77c \\ & = & +2.90 & +3.07a & -5.55c \\ & = & -1.42 & -1.75a & +1.64c \end{array}$$

NORMAL EQUATIONS.

From Lamp East.

$$\begin{array}{lllll} 0 & = & \overset{s.}{+20.97} & +24.12a & -34.85c \\ 0 & = & -31.09 & -34.85a & +55.61c \end{array}$$

$$0 = \overset{s.}{-0.023} \quad +0.151c$$

$$\text{Hence,}\quad c = \overset{s.}{+0.15}$$
$$a = -0.65$$

JUNE 20, 1883.

FUNDAMENTAL EQUATIONS.

Lamp West.

$$\begin{array}{lllll} 0 & = & \overset{s.}{-2.17} & -3.57a & +3.79c \\ & = & -2.17 & -3.59a & +3.81c \\ & = & +0.92 & +1.39a & -3.61c \\ & = & -1.92 & -3.09a & +3.80c \\ & = & -1.92 & -3.11a & +3.82c \\ & = & +1.17 & +1.87a & -3.60c \end{array}$$

NORMAL EQUATIONS.

From Lamp West.

$$\begin{array}{lllll} 0 & = & \overset{s.}{+30.91} & +50.28a & -62.58c \\ 0 & = & -38.65 & -62.58a & +83.90c \end{array}$$

$$0 = \overset{s.}{-0.008} \quad +0.096c$$

$$\text{Hence,}\quad c = \overset{s.}{+0.052}$$
$$a = -0.543$$

JUNE 21, 1883.

FUNDAMENTAL EQUATIONS.

Lamp East.

$$\begin{array}{lllll} 0 & = & \overset{s.}{-1.35} & -2.80a & +2.71c \\ & = & -1.42 & -3.59a & +3.81c \\ & = & +0.97 & +2.86a & -5.61c \\ & = & -1.07 & -2.24a & +2.65c \\ & = & -1.14 & -3.03a & +3.75c \\ & = & +1.25 & +3.42a & -5.67c \end{array}$$

Lamp West.

$$\begin{array}{lllll} 0 & = & \overset{s.}{+1.65} & +\ 3.38a & +\ 6.38c \\ & = & +1.22 & +\ 2.35a & +\ 4.95c \\ & = & -1.50 & -\ 2.44a & -\ 2.18c \\ & = & -6.04 & -12.12a & -15.77c \\ & = & +0.54 & +\ 1.60a & +\ 3.93c \\ & = & +2.11 & +\ 3.95a & +\ 6.39c \\ & = & +1.68 & +\ 2.92a & +\ 4.96c \\ & = & -1.04 & -\ 1.87a & -\ 2.17c \\ & = & -5.58 & -11.55a & -15.76c \\ & = & +1.00 & +\ 2.17a & +\ 3.94c \end{array}$$

NORMAL EQUATIONS.

From Lamp East and Lamp West.

$$\begin{array}{lllll} 0 & = & \overset{s.}{+189.73} & +392.89a & +396.29c \\ 0 & = & +204.41 & +396.29a & +774.68c \end{array}$$

$$0 = \overset{s.}{-0.033} \quad -0.946c$$

$$\text{Hence,}\quad c = \overset{s.}{-0.035}$$
$$a = -0.448$$

From Lamp East.

$$\begin{array}{lllll} 0 & = & \overset{s.}{+21.77} & +54.81a & -\ 74.00c \\ 0 & = & -28.72 & -74.00a & +106.56c \end{array}$$

$$0 = \overset{s.}{+0.112} \quad +0.082c$$

$$\text{Hence,}\quad c = \overset{s.}{-0.137}$$
$$a = -0.581$$

From Lamp West.

$$\begin{array}{lllll} 0 & = & \overset{s.}{+167.96} & +338.08a & +470.29c \\ 0 & = & +233.16 & +470.29a & +668.12c \end{array}$$

$$0 = \overset{s.}{+0.001} \quad -0.035c$$

$$\text{Hence,}\quad c = \overset{s.}{+0.029}$$
$$a = -0.537$$

JUNE 23, 1883.

FUNDAMENTAL EQUATIONS.

Lamp East.

$$\begin{array}{lllll} 0 & = & \overset{s.}{+0.47} & +2.03a & -4.33c \\ & = & -0.54 & -2.72a & +2.73c \\ & = & +0.94 & +2.94a & -5.59c \\ & = & -0.73 & -2.36a & +2.24c \\ & = & -0.79 & -3.51a & +3.83c \\ & = & +0.62 & +2.43a & -4.36c \\ & = & -0.39 & -2.32a & +2.70c \\ & = & +1.09 & +3.34a & -5.62c \\ & = & -0.58 & -1.96a & +2.21c \\ & = & -0.62 & -3.11a & +3.80c \end{array}$$

Lamp West.

$$\begin{array}{lllll} 0 & = & \overset{s.}{-0.80} & -1.45a & -1.11c \\ & = & -0.82 & -2.05a & -1.90c \\ & = & -0.99 & -2.13a & -2.01c \\ & = & -0.95 & -2.43a & -2.42c \end{array}$$

NORMAL EQUATIONS.

From Lamp East and Lamp West.

$$\begin{array}{lllll} 0 & = & \overset{s.}{+26.05} & +90.74a & -\ 87.48c \\ 0 & = & -20.19 & -87.48a & +169.08c \end{array}$$

$$0 = \overset{s.}{+0.056} \quad +0.969c$$

$$\text{Hence,}\quad c = \overset{s.}{-0.058}$$
$$a = -0.342$$

Equations between δa, δc, $\delta\Delta T$ for Solution by Least Squares.

In order that the results derived from the various methods of solution described may be compared, the fundamental equations, both without and with weights, and the resulting normal equations for each date are given on the following pages. The final equation involving $\delta\Delta T$ is also given. In the second set of equations given for each date, the value of c adopted in the previous solution is considered as a constant, or $\delta c = 0$.

June 1, 1883.

Fundamental Equations.

Position.	δ.	Without weights.	Weight factor $= w$.	With weights.
Circle East.	$+7^\circ.8$	$0 = +0^s.020 + 0.57\delta a + 1.01\delta c + \delta\Delta T$	1.4	$0 = +0^s.028 + 0.80\delta a + 1.41\delta c + 1.40\delta\Delta T$
	$+70.4$	$-0.230 - 1.40\delta a + 2.99\delta c + \delta\Delta T$	0.6	$-0.138 - 0.84\delta a + 1.79\delta c + 0.60\delta\Delta T$
	$+85.6$ L. C.	$-0.020 + 10.35\delta a - 13.13\delta c + \delta\Delta T$	0.1	$-0.002 + 1.04\delta a - 1.31\delta c + 0.10\delta\Delta T$
Circle West.	-10.5	$0 = +0.010 + 0.81\delta a - 1.02\delta c + \delta\Delta T$	1.0	$0 = +0.010 + 0.81\delta a - 1.02\delta c + 1.00\delta\Delta T$
	$+33.2$	$-0.020 + 0.18\delta a - 1.20\delta c + \delta\Delta T$	1.4	$-0.028 + 0.25\delta a - 1.68\delta c + 1.40\delta\Delta T$
	$+73.0$	$+0.040 - 1.74\delta a - 3.42\delta c + \delta\Delta T$	0.6	$+0.024 - 1.04\delta a - 2.05\delta c + 0.60\delta\Delta T$

Normal Equations.

Assume: $\Delta T_0 = -14^s.970$; $c_0 = +0^s.200$; $a_0 = +0^s.380$.

Without weights. C. E. and C. W.

$$\begin{array}{rrrrr} 0 = & +0^s.060 & +113.41\delta a & -134.61\delta c & +8.77\delta\Delta T \\ & -0.540 & -134.61\delta a & +196.54\delta c & -14.77\delta\Delta T \\ & -0.200 & +8.77\delta a & -14.77\delta c & +6.00\delta\Delta T \end{array}$$

$$0 = -0.132 \quad +2.437\delta\Delta T$$

$\delta\Delta T = +0^s.054$; $\delta c = +0^s.017$; $\delta a = +0^s.015$.

With weights. C. E. and C. W.

$$\begin{array}{rrrrr} 0 = & +0^s.112 & +4.23\delta a & -0.85\delta c & +1.26\delta\Delta T \\ & -0.217 & -0.85\delta a & +14.97\delta c & -1.69\delta\Delta T \\ & -0.059 & +1.26\delta a & -1.69\delta c & +5.65\delta\Delta T \end{array}$$

$$0 = +0.0055 \quad -0.2641\delta\Delta T$$

$\delta\Delta T = -0^s.0208$; $\delta c = +0^s.0154$; $\delta a = -0^s.025$.

With weights. C. E. only.

$$\begin{array}{rrrrr} 0 = & +0^s.136 & +2.43\delta a & -1.73\delta c & +0.72\delta\Delta T \\ & -0.205 & -1.73\delta a & +6.91\delta c & +2.91\delta\Delta T \\ & -0.044 & +0.72\delta a & +2.91\delta c & +2.33\delta\Delta T \end{array}$$

$$0 = +0.0033 \quad -0.0147\delta\Delta T$$

$\delta\Delta T = +0^s.224$; $\delta c = -0^s.114$; $\delta a = -0^s.201$.

With weights. C. W. only.

$$\begin{array}{rrrrr} 0 = & -0^s.024 & +1.80\delta a & +0.88\delta c & +0.54\delta\Delta T \\ & -0.012 & +0.88\delta a & +8.06\delta c & -4.60\delta\Delta T \\ & -0.015 & +0.54\delta a & -4.60\delta c & +3.32\delta\Delta T \end{array}$$

$$0 = -0.00071 \quad -1.2810\delta\Delta T$$

$\delta\Delta T = -0^s.0005$; $\delta c = +0^s.0004$; $\delta a = +0^s.0133$.

Solution for $\delta c = 0$.

Without weights. C. E. and C. W.

$$0 = -0.024 \quad +0.607\delta\Delta T$$

$\delta\Delta T = +0^s.040$; $\delta c = 0^s.000$; $\delta a = -0^s.004$.

With weights. C. E. and C. W.

$$0 = -0.0733 \quad +4.4226\delta\Delta T$$

$\delta\Delta T = +0^s.0164$; $\delta c = 0^s.000$; $\delta a = -0^s.027$.

With weights. C. E. only.

$$0 = -0.1171 \quad +2.9398\delta\Delta T$$

$\delta\Delta T = +0^s.040$; $\delta c = 0^s.000$; $\delta a = -0^s.067$.

With weights. C. W. only.

$$0 = +0.0145 \quad -5.8481\delta\Delta T$$

$\delta\Delta T = +0^s.0025$; $\delta c = 0^s.000$; $\delta a = +0^s.0132$.

June 2, 1883.

Fundamental Equations.

Position.	δ.	Without weights.	Weight factor $=w$.	Known terms for C. W. only.	With weights.
Circle West.	-22.6	$0 = \overset{s.}{+0.015} +0.98\delta a +1.08\delta c +\delta\Delta T$	0.9	-0.058	$0 = \overset{s.}{+0.014} +0.88\delta a +0.97\delta c +0.90\delta\Delta T$
	$+19.7$	$-0.018 +0.40\delta a +1.07\delta c +\delta\Delta T$	1.7	-0.122	$-0.031 +0.68\delta a +1.82\delta c +1.70\delta\Delta T$
	$+53.2$	$+0.165 -0.32\delta a +1.68\delta c +\delta\Delta T$	1.3	$+0.182$	$+0.214 -0.42\delta a +2.18\delta c +1.30\delta\Delta T$
	$+71.8$ L. C.	$+0.045 +2.93\delta a -3.21\delta c +\delta\Delta T$	0.6	-0.039	$+0.028 +1.76\delta a -1.93\delta c +0.60\delta\Delta T$
				For C. E. only.	
Circle East.	-7.6	$0 = -0.042 +0.77\delta a -1.02\delta c +\delta\Delta T$	1.7	$+0.187$	$0 = -0.071 -1.31\delta a -1.73\delta c +1.70\delta\Delta T$
	$+53.2$	$-0.185 -0.35\delta a -1.72\delta c +\delta\Delta T$	1.3	-0.188	$-0.241 -0.45\delta a -2.24\delta c +1.30\delta\Delta T$
	$+30.4$	$-0.085 +0.22\delta a -1.18\delta c +\delta\Delta T$	1.4	$+0.000$	$-0.119 +0.31\delta a -1.65\delta c +1.40\delta\Delta T$
	$+57.0$	$-0.075 -0.46\delta a -1.85\delta c +\delta\Delta T$	0.8	-0.032	$-0.060 -0.37\delta a -1.48\delta c +0.80\delta\Delta T$
	$+71.8$ L. C.	$-0.005 +2.93\delta a +3.21\delta c +\delta\Delta T$	0.4	$+0.020$	$-0.002 +1.19\delta a +1.28\delta c +0.40\delta\Delta T$
	$+64.9$	$+0.055 -0.90\delta a -2.36\delta c +\delta\Delta T$	0.7	$+0.049$	$+0.038 -0.63\delta a -1.65\delta c +0.70\delta\Delta T$
	$+78.1$	$+0.015 -2.83\delta a -4.85\delta c +\delta\Delta T$	0.4	-0.004	$+0.006 -1.13\delta a -1.94\delta c +0.40\delta\Delta T$
	$+66.9$ L. C.	$+0.255 +2.40\delta a +2.54\delta c +\delta\Delta T$	0.5	$+0.150$	$+0.127 +1.20\delta a +1.27\delta c +0.50\delta\Delta T$
	$+77.3$ L. C.	$+0.085 +3.95\delta a +4.55\delta c +\delta\Delta T$	0.4	$+0.068$	$+0.034 +1.58\delta a +1.82\delta c +0.40\delta\Delta T$
	$+69.0$	$+0.235 -1.25\delta a -2.79\delta c +\delta\Delta T$	0.7	$+0.168$	$+0.164 -0.85\delta a -1.95\delta c +0.70\delta\Delta T$
	$+61.9$ L. C.	$-0.155 +3.58\delta a +4.06\delta c +\delta\Delta T$	0.6	-0.054	$-0.094 +2.15\delta a +2.44\delta c +0.60\delta\Delta T$
C. West.	$+26.5$	$0 = +0.148 +0.24\delta a +1.24\delta c +\delta\Delta T$	1.7		$+0.252 +0.41\delta a +2.11\delta c +1.70\delta\Delta T$

Normal Equations.

Assume: $\Delta T_0 = \overset{s.}{-14.325}$; $c_0 = \overset{s.}{-0.176}$; $a_0 = \overset{s.}{+0.507}$.

Without weights. C. E and C. W.

$$
\begin{array}{rrrrr}
0 = & \overset{s.}{+0.165} & +63.97\delta a & +59.59\delta c & +12.29\delta\Delta T \\
 & +0.446 & +59.59\delta a & +116.58\delta c & +0.45\delta\Delta T \\
 & +0.453 & +12.29\delta a & +0.45\delta c & +16.00\delta\Delta T
\end{array}
$$

$$0 = +0.0192 -0.850\delta\Delta T$$

$$\delta\Delta T = \overset{s.}{+0.023};\quad \delta c = \overset{s.}{+0.000};\quad \delta a = \overset{s.}{-0.007}.$$

With weights. C. E. and C. W.

$$
\begin{array}{rrrrr}
0 = & \overset{s.}{-0.115} & +19.22\delta a & +13.48\delta c & +6.45\delta\Delta T \\
 & +1.447 & +13.48\delta a & +52.88\delta c & -0.08\delta\Delta T \\
 & +0.199 & +6.45\delta a & -0.08\delta c & +17.89\delta\Delta T
\end{array}
$$

$$0 = -0.0158 -0.600\delta\Delta T$$

$$\delta\Delta T = \overset{s.}{-0.026};\quad \delta c = \overset{s.}{-0.038};\quad \delta a = \overset{s.}{+0.041}.$$

With weights. C. E. only.

$\Delta T = -14.410$; $c_0 = -0.280$; $a_0 = +0.673$.

$$
\begin{array}{rrrrr}
0 = & \overset{s.}{+0.368} & +14.54\delta a & +14.84\delta c & +3.29\delta\Delta T \\
 & -0.048 & +14.84\delta a & +35.71\delta c & -9.30\delta\Delta T \\
 & +0.276 & +3.29\delta a & -9.30\delta c & +9.25\delta\Delta T
\end{array}
$$

$$0 = +0.0040 -0.0415\delta\Delta T$$

$$\delta\Delta T = \overset{s.}{+0.096};\quad \delta c = \overset{s.}{+0.080};\quad \delta a = \overset{s.}{-0.129}.$$

With weights. C. W. only.

$\Delta T = -14.345$; $c_0 = -0.189$; $a_0 = +0.456$.

$$
\begin{array}{rrrrr}
0 = & \overset{s.}{-0.279} & +4.51\delta a & -2.23\delta c & +2.46\delta\Delta T \\
 & +0.194 & -2.23\delta a & +12.72\delta c & +5.63\delta\Delta T \\
 & -0.045 & +2.46\delta a & +5.63\delta c & +5.75\delta\Delta T
\end{array}
$$

$$0 = -0.0038 -0.0195\delta\Delta T$$

$$\delta\Delta T = \overset{s.}{-0.200};\quad \delta c = \overset{s.}{+0.113};\quad \delta a = \overset{s.}{+0.227}.$$

Solution for $\delta c = 0$.

Without weights. C. E. and C. W.

$$0 = +0.034 +1.110\delta\Delta T$$

$$\delta\Delta T = \overset{s.}{-0.031};\quad \delta c = \overset{s.}{+0.000};\quad \delta a = \overset{s.}{+0.003}.$$

With weights. C. E. and C. W.

$$0 = +0.0368 + 2.439\delta\Delta T$$

$$\delta\Delta T = \overset{s.}{-0.015};\quad \delta c = \overset{s.}{0.000};\quad \delta a = \overset{s.}{+0.011}.$$

With weights. C. E. only.

$$0 = +0.0586 +2.5853\delta\Delta T$$

$$\delta\Delta T = \overset{s.}{-0.022};\quad \delta c = \overset{s.}{0.000};\quad \delta a = \overset{s.}{-0.021}.$$

With weights. C. W. only.

$$0 = +0.0436 + 1.792\delta\Delta T$$

$$\delta\Delta T = \overset{s.}{-0.024};\quad \delta c = \overset{s.}{0.000};\quad \delta a = \overset{s.}{+0.074}.$$

JUNE 4, 1883.

FUNDAMENTAL EQUATIONS.

Position.	δ.	Without weights.	Weight factor $= w$.	With weights.
Circle East.	-16.5	$0 = \overset{s.}{-0.025} + 0.90\delta a + 1.05\delta c + \delta\Delta T$	1.3	$0 = \overset{s.}{-0.032} + 1.17\delta a + 1.36\delta c + 1.30\delta\Delta T$
	$+19.7$	$+0.002 + 0.40\delta a + 1.06\delta c + \delta\Delta T$	1.7	$+0.003 + 0.68\delta a + 1.80\delta c + 1.70\delta\Delta T$
	$+57.1$	$-0.092 - 0.51\delta a + 1.91\delta c + \delta\Delta T$	1.5	$-0.138 - 0.76\delta a + 2.86\delta c + 1.50\delta\Delta T$
	$+21.0$	$+0.015 + 0.37\delta a + 1.11\delta c + \delta\Delta T$	1.7	$+0.025 + 0.63\delta a + 1.89\delta c + 1.70\delta\Delta T$
	$+73.0$	$-0.005 - 1.74\delta a + 3.42\delta c + \delta\Delta T$	0.5	$-0.002 - 0.87\delta a + 1.71\delta c + 0.50\delta\Delta T$
	$+72.5$ L. C.	$-0.045 + 3.01\delta a - 3.32\delta c + \delta\Delta T$	0.4	$-0.018 + 1.20\delta a - 1.33\delta c + 0.40\delta\Delta T$
	$+71.9$ L. C.	$-0.105 + 2.93\delta a - 3.21\delta c + \delta\Delta T$	0.4	$-0.042 + 1.17\delta a - 1.28\delta c + 0.40\delta\Delta T$
	$+79.1$ L. C.	$-0.055 + 4.51\delta a - 5.29\delta c + \delta\Delta T$	0.3	$-0.017 + 1.35\delta a - 1.59\delta c + 0.30\delta\Delta T$
Circle West.	-19.2	$0 = -0.002 + 0.89\delta a - 1.04\delta c + \delta\Delta T$	1.6	$0 = -0.003 + 1.42\delta a - 1.66\delta c + 1.60\delta\Delta T$
	$+11.0$	$+0.055 + 0.52\delta a - 1.03\delta c + \delta\Delta T$	1.4	$+0.077 + 0.73\delta a - 1.46\delta c + 1.40\delta\Delta T$
	$+57.6$	$+0.047 - 0.54\delta a - 1.93\delta c + \delta\Delta T$	1.7	$+0.080 - 0.92\delta a - 3.28\delta c + 1.70\delta\Delta T$
	$+78.2$	$+0.285 - 2.83\delta a - 4.85\delta c + \delta\Delta T$	0.4	$+0.114 - 1.13\delta a - 1.94\delta c + 0.40\delta\Delta T$
	$+66.9$ L. C.	$+0.085 + 2.40\delta a + 2.54\delta c + \delta\Delta T$	0.5	$+0.043 + 1.20\delta a + 1.27\delta c + 0.50\delta\Delta T$
	$+74.6$	$-0.325 - 2.01\delta a - 3.77\delta c + \delta\Delta T$	0.5	$-0.163 - 1.01\delta a - 1.89\delta c + 0.50\delta\Delta T$
	$+78.2$	$+0.235 - 2.85\delta a - 4.87\delta c + \delta\Delta T$	0.4	$+0.094 - 1.14\delta a - 1.95\delta c + 0.40\delta\Delta T$
	$+76.2$	$-0.005 - 2.33\delta a - 4.18\delta c + \delta\Delta T$	0.5	$-0.002 - 1.16\delta a - 2.09\delta c + 0.50\delta\Delta T$

NORMAL EQUATIONS.

Assume: $\Delta T_0 = \overset{s.}{-13.375}$; $c_0 = \overset{s.}{+0.260}$; $a_0 = +0.890$.

Without weights. C. E. and C. W.

$$
\begin{array}{rrrrr}
0 = & \overset{s.}{-1.257} & +75.09\delta a & +\ 2.19\delta c & +\ 3.12\delta\Delta T \\
& -0.633 & +\ 2.19\delta a & +159.33\delta c & -22.40\delta\Delta T \\
& +0.065 & +\ 3.12\delta a & -\ 22.40\delta c & +16.00\delta\Delta T
\end{array}
$$

Hence $0 = -\ 0.0002 - 0.0509\delta\Delta T$

$\delta\Delta T = \overset{s.}{-0.004}$; $\delta c = \overset{s.}{+0.003}$; $\delta a = \overset{s.}{+0.017}$.

With weights. C. E. and C. W.

$$
\begin{array}{rrrrr}
0 = & \overset{s.}{-0.045} & +17.99\delta a & +\ 4.94\delta c & +\ 3.86\delta\Delta T \\
& -0.691 & +\ 4.94\delta a & +58.46\delta c & -\ 1.51\delta\Delta T \\
& +0.030 & +\ 3.86\delta a & -\ 1.51\delta c & +18.86\delta\Delta T
\end{array}
$$

Hence $0 = -0.0002 - 0.4697\delta\Delta T$

$\delta\Delta T = \overset{s.}{-0.000}$; $\delta c = \overset{s.}{+0.012}$; $\delta a = \overset{s.}{-0.001}$.

With weights. C. E. only.

$$
\begin{array}{rrrrr}
0 = & \overset{s.}{-0.006} & +8.20\delta a & -\ 4.91\delta c & +\ 3.52\delta\Delta T \\
& -0.285 & -4.91\delta a & +25.70\delta c & +11.67\delta\Delta T \\
& -0.232 & +3.52\delta a & +11.67\delta c & +10.38\delta\Delta T
\end{array}
$$

Hence $0 = +0.0017 - 0.0154\delta\Delta T$

$\delta\Delta T = \overset{s.}{+0.110}$; $\delta c = \overset{s.}{-0.054}$; $\delta a = \overset{s.}{-0.079}$.

With weights. C. W. only.

$$
\begin{array}{rrrrr}
0 = & \overset{s.}{-0.039} & +9.79\delta a & +\ 9.85\delta c & +\ 0.34\delta\Delta T \\
& -0.406 & +9.85\delta a & +32.76\delta c & -13.18\delta\Delta T \\
& +0.262 & +0.34\delta a & -13.18\delta c & +\ 8.48\delta\Delta T
\end{array}
$$

Hence $0 = -0.0033 - 0.0108\delta\Delta T$

$\delta\Delta T = \overset{s.}{-0.306}$; $\delta c = \overset{s.}{-0.165}$; $\delta a = \overset{s.}{+0.180}$.

SOLUTION FOR $\delta c = 0$.

Without weights. C. E. and C. W.

$0 = +0.038 + 5.0866\delta\Delta T$

$\delta\Delta T = \overset{s.}{-0.007}$; $\delta c = \overset{s.}{0.000}$; $\delta a = \overset{s.}{+0.010}$.

With weights. C. E. and C. W.

$0 = +0.0103 + 4.6714\delta\Delta T$

$\delta\Delta T = \overset{s.}{-0.022}$; $\delta c = \overset{s.}{0.000}$; $\delta a = \overset{s.}{+0.007}$.

With weights. C. E. only.

$0 = -0.0652 + 2.5196\delta\Delta T$

$\delta\Delta T = \overset{s.}{+0.0026}$; $\delta c = \overset{s.}{0.000}$; $\delta a = \overset{s.}{-0.010}$.

With weights. C. W. only.

$0 = +0.7746 + 24.907\delta\Delta T$

$\delta\Delta T = \overset{s.}{-0.031}$; $\delta c = \overset{s.}{0.000}$; $\delta a = \overset{s.}{+0.005}$.

June 5, 1883.

Fundamental Equations.

Position.	δ.	Without weights.	Weight factor $=w$.	Known terms for C. E. only.	With weights.
	°	s.		s.	s.
Circle East.	-16.6	$0 = +0.071 + 0.90\delta a + 1.05\delta c + \delta\Delta T$	1.3	$+0.096$	$0 = +0.092 + 1.17\delta a + 1.36\delta c + 1.30\delta\Delta T$
	$+21.8$	$-0.021 + 0.37\delta a + 1.09\delta c + \delta\Delta T$	2.0	$+0.072$	$-0.042 + 0.74\delta a + 2.18\delta c + 2.00\delta\Delta T$
	$+57.1$	$-0.132 - 0.51\delta a + 1.91\delta c + \delta\Delta T$	1.5	-0.074	$-0.198 - 0.76\delta a + 2.86\delta c - 1.50\delta\Delta T$
	$+73.0$	$-0.079 - 1.74\delta a + 3.42\delta c + \delta\Delta T$	0.5	$+0.007$	$-0.039 - 0.87\delta a + 1.71\delta c + 0.50\delta\Delta T$
	$+72.5$ L. C.	$+0.051 + 3.01\delta a - 3.32\delta c + \delta\Delta T$	0.4	$+0.074$	$+0.020 + 1.20\delta a - 1.33\delta c + 0.40\delta\Delta T$
	$+71.9$ L. C.	$-0.139 + 2.93\delta a - 3.21\delta c + \delta\Delta T$	0.4	-0.014	$-0.056 + 1.17\delta a - 1.28\delta c + 0.40\delta\Delta T$
	$+78.1$	$-0.059 - 2.83\delta a + 4.85\delta c + \delta\Delta T$	0.4	$+0.022$	$-0.024 - 1.13\delta a + 1.94\delta c + 0.40\delta\Delta T$
				For C. E. only	
Circle West.	-20.9	$0 = +0.081 + 0.96\delta a - 1.07\delta c + \delta\Delta T$	1.3	$+0.292$	$0 = +0.105 + 1.25\delta a - 1.39\delta c + 1.30\delta\Delta T$
	$+21.8$	$+0.091 + 0.38\delta a - 1.08\delta c + \delta\Delta T$	1.0	$+0.080$	$+0.091 + 0.38\delta a - 1.08\delta c + 1.00\delta\Delta T$
	$+60.2$	$+0.034 - 0.61\delta a - 2.01\delta c + \delta\Delta T$	1.4	-0.038	$+0.048 - 0.85\delta a - 2.81\delta c + 1.40\delta\Delta T$
	$+78.1$	$-0.179 - 2.83\delta a - 4.85\delta c + \delta\Delta T$	0.4	-0.124	$-0.072 - 1.13\delta a - 1.94\delta c + 0.40\delta\Delta T$
	$+66.9$ L. C.	$+0.061 + 2.40\delta a + 2.54\delta c + \delta\Delta T$	0.5	0.055	$+0.030 - 1.20\delta a - 1.27\delta c + 0.50\delta\Delta T$
	$+72.3$ L. C.	$+0.201 + 2.99\delta a + 3.29\delta c + \delta\Delta T$	0.4	$+0.020$	$+0.081 + 1.20\delta a + 1.32\delta c + 0.40\delta\Delta T$
	$+74.5$	$+0.361 - 2.01\delta a - 3.77\delta c + \delta\Delta T$	0.5	$+0.120$	$+0.180 - 1.00\delta a - 1.88\delta c + 0.50\delta\Delta T$
	$+78.1$	$+0.171 - 2.85\delta a - 4.87\delta c + \delta\Delta T$	0.4	$+0.020$	$+0.068 - 1.14\delta a - 1.95\delta c + 0.40\delta\Delta T$

Normal Equations.

Assume: $\Delta T_0 = -13\overset{s.}{.}059$; $c_0 = +0\overset{s.}{.}240$; $a_0 = +1.200$.

Without weights. C. E. and C. W.

$$\begin{aligned}
0 &= +0\overset{s.}{.}306 + 66.91\delta a + 12.21\delta c + 0.56\delta\Delta T \\
&\quad -1.243 + 12.21\delta a + 147.55\delta c - 6.03\delta\Delta T \\
&\quad +0.513 + 0.56\delta a - 6.03\delta c + 15.00\delta\Delta T
\end{aligned}$$

Hence $0 = -0.0357 - 1.1518\delta\Delta T$

$\delta\Delta T = -0\overset{s.}{.}031$; $\delta c = +0\overset{s.}{.}008$; $\delta a = -0\overset{s.}{.}005$.

With weights. C. E. and C. W.

$$\begin{aligned}
0 &= +0\overset{s.}{.}327 + 16.23\delta a + 3.88\delta c + 2.40\delta\Delta T \\
&\quad -1.167 + 3.88\delta a + 50.31\delta c + 2.87\delta\Delta T \\
&\quad +0.124 + 2.40\delta a + 2.87\delta c + 14.30\delta\Delta T
\end{aligned}$$

Hence $0 = -0.0048 - 0.49000\delta\Delta T$

$\delta\Delta T = -0\overset{s.}{.}010$; $\delta c = +0\overset{s.}{.}026$; $\delta a = -0\overset{s.}{.}025$.

With weights. C. E. only.

$\Delta T = -12.876$; $c_0 = +0.160$; $a_0 = +1.090$.

$$\begin{aligned}
0 &= +0\overset{s.}{.}263 + 7.35\delta a - 5.75\delta c + 1.92\delta\Delta T \\
&\quad +0.051 - 5.75\delta a + 24.87\delta c + 11.02\delta\Delta T \\
&\quad +0.195 + 1.92\delta a + 11.02\delta c + 8.67\delta\Delta T
\end{aligned}$$

Hence $0 = +0.0016 - 0.0245\delta\Delta T$

$\delta\Delta T = +0\overset{s.}{.}065$; $\delta c = -0\overset{s.}{.}053$; $\delta a = -0\overset{s.}{.}094$.

With weights. C. W. only.

$\Delta T = -13.370$; $c_0 = +0.050$; $a_0 = +1.460$.

$$\begin{aligned}
0 &= +0\overset{s.}{.}382 + 8.88\delta a + 9.63\delta c + 0.48\delta\Delta T \\
&\quad -0.453 + 9.63\delta a + 25.44\delta c - 8.15\delta\Delta T \\
&\quad +0.405 + 0.48\delta a - 8.15\delta c + 5.63\delta\Delta T
\end{aligned}$$

Hence $0 = +0.0124 - 0.0926\delta\Delta T$

$\delta\Delta T = +0\overset{s.}{.}134$; $\delta c = +0\overset{s.}{.}135$; $\delta a = -0\overset{s.}{.}197$.

Solution for $\delta c = 0$.

Without weights. C. E. and C. W.

$0 = +0.620 + 26.778\delta\Delta T$

$\delta\Delta T = -0\overset{s.}{.}023$; $\delta c = 0\overset{s.}{.}000$; $\delta a = -0\overset{s.}{.}005$.

With weights. C. E. and C. W.

$0 = +0.0316 + 5.8104\delta\Delta T$

$\delta\Delta T = -0\overset{s.}{.}005$; $\delta c = 0\overset{s.}{.}000$; $\delta a = -0\overset{s.}{.}019$.

With weights. C. E. only.

$0 = +0.0658 + 4.2544\delta\Delta T$

$\delta\Delta T = -0\overset{s.}{.}016$; $\delta c = 0\overset{s.}{.}000$; $\delta a = -0\overset{s.}{.}032$.

With weights. C. W. only.

$0 = +0.8007 + 11.6751\delta\Delta T$

$\delta\Delta T = -0\overset{s.}{.}069$; $\delta c = 0\overset{s.}{.}000$; $\delta a = -0\overset{s.}{.}039$.

June 17, 1883.

Fundamental Equations.

Position.	δ.	Without weights.	Weight factor $=w$.	With weights.
Lamp East.	$+19^{\circ}.5$	$0 = +0^{s}.042 +0.46\delta a +1.07\delta c +\delta\Delta T$	2.2	$0 = +0^{s}.092 +1.01\delta a +2.35\delta c +2.20\delta\Delta T$
	$+78.1$	$+0.040 -2.63\delta a +4.87\delta c +\delta\Delta T$	0.4	$+0.016 -1.05\delta a +1.95\delta c +0.40\delta\Delta T$
Lamp West.	-9.2	$0 = -0.067 +0.83\delta a -1.02\delta c +\delta\Delta T$	1.7	$0 = -0.114 +1.41\delta a -1.73\delta c +1.70\delta\Delta T$
	$+76.3$	$-0.090 -2.13\delta a -4.18\delta c +\delta\Delta T$	0.5	$-0.045 -1.06\delta a -2.09\delta c +0.50\delta\Delta T$

Normal Equations.

Assume: $\Delta T_0 = +6^{s}.560$; $c_0 = +0^{s}.310$; $a_0 = -0^{s}.680$.

Without weights. L. E. and L. W.

$$
\begin{array}{rrrrrr}
0 & = & +0^{s}.050 & +12.36\delta a & -4.27\delta c & -3.47\delta\Delta T \\
 & & +0.684 & -4.27\delta a & +43.37\delta c & +0.74\delta\Delta T \\
 & & -0.075 & -3.47\delta a & +0.74\delta c & +4.00\delta\Delta T
\end{array}
$$

$$0 = -0.0016 +0.0876\delta\Delta T$$

$\delta\Delta T = +0^{s}.018$; $\delta c = -0^{s}.016$; $\delta a = -0^{s}.004$.

With weights. L. E. and L. W.

$$
\begin{array}{rrrrrr}
0 & = & -0^{s}.037 & +5.23\delta a & +0.10\delta c & +3.67\delta\Delta T \\
 & & +0.538 & +0.10\delta a & +16.68\delta c & +1.97\delta\Delta T \\
 & & -0.008 & +3.67\delta a & +1.97\delta c & +8.14\delta\Delta T
\end{array}
$$

$$0 = -0.0001 +0.0088\delta\Delta T$$

$\delta\Delta T = +0^{s}.011$; $\delta c = -0^{s}.034$; $\delta a = 0^{s}.000$.

With weights. L. E. only.

$$
\begin{array}{rrrrrr}
0 & = & +0^{s}.076 & +2.12\delta a & +0.32\delta c & +1.80\delta\Delta T \\
 & & +0.247 & +0.32\delta a & +9.32\delta c & +5.95\delta\Delta T \\
 & & +0.208 & +1.80\delta a & +5.95\delta c & +5.00\delta\Delta T
\end{array}
$$

$$0 = -0.00002 +0.0014\delta\Delta T$$

$\delta\Delta T = +0^{s}.014$; $\delta c = -0^{s}.033$; $\delta a = -0^{s}.043$.

With weights. L. W. only.

$$
\begin{array}{rrrrrr}
0 & = & -0^{s}.113 & +3.11\delta a & -0.22\delta c & +1.87\delta\Delta T \\
 & & +0.291 & -0.22\delta a & +7.36\delta c & -3.98\delta\Delta T \\
 & & -0.216 & +1.87\delta a & -3.98\delta c & +3.14\delta\Delta T
\end{array}
$$

$$0 = +0.0050 -0.0605\delta\Delta T$$

$\delta\Delta T = +0^{s}.083$; $\delta c = +0^{s}.005$; $\delta a = -0^{s}.013$.

Solution for $\delta c = 0$.

Without weights. L. E. and L. W.

$$0 = -0.018 +0.872\delta\Delta T$$

$\delta\Delta T = +0^{s}.020$; $\delta c = 0^{s}.000$; $\delta a = -0^{s}.003$.

With weights. L. E. and L. W.

$$0 = +0.005 +1.517\delta\Delta T$$

$\delta\Delta T = -0^{s}.003$; $\delta c = 0^{s}.000$; $\delta a = +0^{s}.009$.

With weights. L. E. only.

$$0 = +0.0797 +1.929\delta\Delta T$$

$\delta\Delta T = -0^{s}.041$; $\delta c = 0^{s}.000$; $\delta a = -0^{s}.001$.

With weights. L. W. only.

$$0 = -0.0793 +1.0778\delta\Delta T$$

$\delta\Delta T = +0^{s}.071$; $\delta c = 0^{s}.000$; $\delta a = -0^{s}.007$.

June 19, 1883.

Fundamental Equations.

Position.	δ.	Without weights.	Weight factor $=w$.	With weights.
Lamp East.	$-3^{\circ}.6$	$0 = -0^{s}.010 +0.75\delta a +1.00\delta c +\delta\Delta T$	1.4	$0 = -0^{s}.014 +1.05\delta a +1.40\delta c +1.40\delta\Delta T$
	$+28.3$	$+0.005 +0.34\delta a +1.13\delta c +\delta\Delta T$	1.4	$+0.007 +0.48\delta a +1.58\delta c +1.40\delta\Delta T$
	$+59.8$	$+0.000 -0.49\delta a +1.99\delta c +\delta\Delta T$	0.8	$+0.000 -0.43\delta a +1.59\delta c +0.80\delta\Delta T$
	$+64.9$	$-0.020 -0.79\delta a +2.36\delta c +\delta\Delta T$	0.7	$-0.014 -0.69\delta a +1.65\delta c +0.70\delta\Delta T$
	$+66.9$ L.C.	$-0.070 +2.35\delta a -2.55\delta c +\delta\Delta T$	0.5	$-0.035 +1.18\delta a -1.28\delta c +0.50\delta\Delta T$
	$+74.6$	$+0.040 -1.84\delta a +3.77\delta c +\delta\Delta T$	0.5	$+0.020 -0.92\delta a +1.88\delta c +0.50\delta\Delta T$
	$+77.3$ L.C.	$+0.070 +3.82\delta a -4.55\delta c +\delta\Delta T$	0.4	$+0.028 +1.53\delta a -1.82\delta c +0.40\delta\Delta T$
	$+67.8$	$-0.040 -1.00\delta a +2.64\delta c +\delta\Delta T$	0.7	$-0.028 -0.70\delta a +1.85\delta c +0.70\delta\Delta T$

JUNE 19, 1883.

NORMAL EQUATIONS.

Assume: $\Delta T = +\overset{s.}{6.500}$; $c_0 = +\overset{s.}{0.150}$; $a_0 = -\overset{s.}{0.650}$.

Without weights. L. E. only.

$$
\begin{array}{rrrrrr}
0 = & +\overset{s.}{0.080} & +26.04\delta a & -34.66\delta c & +3.14\delta\Delta T \\
 & -0.146 & -34.66\delta a & +60.19\delta c & +5.79\delta\Delta T \\
 & -0.025 & +\ 3.14\delta a & +\ 5.79\delta c & +8.00\delta\Delta T
\end{array}
$$

$$0 = +0.0009 \quad -0.0488\delta\Delta T$$

$\delta\Delta T = +\overset{s.}{0.018}$; $\delta c = -\overset{s.}{0.011}$; $\delta a = -\overset{s.}{0.019}$.

With weights. L. E. only.

$$
\begin{array}{rrrrrr}
0 = & -\overset{s.}{0.038} & +7.06\delta a & -\ 6.91\delta c & +1.57\delta\Delta T \\
 & -0.052 & -6.91\delta a & +21.61\delta c & +7.47\delta\Delta T \\
 & -0.037 & +1.57\delta a & +\ 7.47\delta c & +6.20\delta\Delta T
\end{array}
$$

$$0 = -0.0020 \quad -0.0318\delta\Delta T$$

$\delta\Delta T = -\overset{s.}{0.063}$; $\delta c = +\overset{s.}{0.044}$; $\delta a = +\overset{s.}{0.062}$.

SOLUTION FOR $\delta c = 0$.

Without weights. L. E. only.

$$0 = -0.011 \quad +2.427\delta\Delta T$$

$\delta\Delta T = +\overset{s.}{0.005}$; $\delta c = \overset{s.}{0.000}$; $\delta a = -\overset{s.}{0.004}$.

With weights. L. E. only.

$$0 = -0.019 \quad +3.728\delta\Delta T$$

$\delta\Delta T = +\overset{s.}{0.005}$; $\delta c = \overset{s.}{0.000}$; $\delta a = +\overset{s.}{0.004}$.

JUNE 20, 1883.

FUNDAMENTAL EQUATIONS.

Position.	δ.	Without weights.	Weight factor $= w$.	With weights.
Lamp West.	$-\overset{\circ}{19.1}$	$0 = -\overset{s.}{0.032} +0.96\delta a +1.06\delta c +\delta\Delta T$	1.6	$0 = -\overset{s.}{0.051} +1.54\delta a +1.70\delta c +1.60\delta\Delta T$
	$+ 18.8$	$-0.020 +0.48\delta a +1.05\delta c +\delta\Delta T$	1.4	$-0.028 +0.67\delta a +1.47\delta c +1.40\delta\Delta T$
	$+ 64.9$	$+0.135 -0.79\delta a +2.36\delta c +\delta\Delta T$	0.7	$+0.094 -0.55\delta a +1.65\delta c +0.70\delta\Delta T$
	$+ 78.1$	$-0.085 -2.61\delta a +4.85\delta c +\delta\Delta T$	0.4	$-0.034 -1.04\delta a +1.94\delta c +0.40\delta\Delta T$
	$+ 78.1$	$-0.075 -2.63\delta a +4.87\delta c +\delta\Delta T$	0.4	$-0.030 -1.05\delta a +1.95\delta c +0.40\delta\Delta T$
	$+ 66.9$ L.C.	$-0.045 +2.35\delta a -2.55\delta c +\delta\Delta T$	0.5	$-0.022 +1.18\delta a -1.28\delta c +0.50\delta\Delta T$

NORMAL EQUATIONS.

Assume: $\Delta T_0 = +\overset{s.}{6.405}$; $c_0 = +\overset{s.}{0.050}$; $a_0 = -\overset{s.}{0.540}$.

Without weights. L. W. only.

$$
\begin{array}{rrrrrr}
0 = & +\overset{s.}{0.165} & +21.02\delta a & -31.80\delta c & -\ 2.24\delta\Delta T \\
 & -0.398 & -31.80\delta a & +61.53\delta c & +11.64\delta\Delta T \\
 & -0.122 & -\ 2.24\delta a & +11.64\delta c & +\ 6.00\delta\Delta T
\end{array}
$$

$$0 = +0.0013 \quad -0.0956\delta\Delta T$$

$\delta\Delta T = +\overset{s.}{0.014}$; $\delta c = +\overset{s.}{0.003}$; $\delta a = -\overset{s.}{0.002}$.

With weights. L. W. only.

$$
\begin{array}{rrrrrr}
0 = & -\overset{s.}{0.109} & +6.69\delta a & -\ 2.89\delta c & +2.77\delta\Delta T \\
 & -0.069 & -2.89\delta a & +16.97\delta c & +6.86\delta\Delta T \\
 & -0.092 & +2.77\delta a & +\ 6.86\delta c & +5.58\delta\Delta T
\end{array}
$$

$$0 = -0.0005 \quad -0.0131\delta\Delta T$$

$\delta\Delta T = -\overset{s.}{0.038}$; $\delta c = +\overset{s.}{0.027}$; $\delta a = +\overset{s.}{0.044}$.

SOLUTION FOR $\delta c = 0$.

Without weights. L. W. only.

$$0 = -0.047 \quad +2.572\delta\Delta T$$

$\delta\Delta T = +\overset{s.}{0.018}$; $\delta c = \overset{s.}{0.000}$; $\delta a = -\overset{s.}{0.006}$.

With weights. L. W. only.

$$0 = -0.017 \quad +1.600\delta\Delta T$$

$\delta\Delta T = +\overset{s.}{0.011}$; $\delta c = \overset{s.}{0.000}$; $\delta a = +\overset{s.}{0.012}$.

June 21, 1883

Fundamental Equations.

Position.	δ.	Without weights.	Weight factor $= w$.	Known terms for L. E. only.	With weights.
	°	s.			s.
Lamp East.	-19.2	$0 = +0.137 + 0.96\delta a + 1.06\delta c + \delta\Delta T$	1.6	-0.035	$0 = +0.219 + 1.54\delta a + 1.70\delta c + 1.60\delta\Delta T$
	$+23.1$	$+0.107 + 0.40\delta a + 1.12\delta c + \delta\Delta T$	2.4	$+0.025$	$+0.257 + 0.96\delta a + 2.69\delta c + 2.40\delta\Delta T$
	$+74.6$	$-0.060 - 1.84\delta a + 3.77\delta c + \delta\Delta T$	0.5	-0.061	$-0.030 - 0.92\delta a + 1.88\delta c + 0.50\delta\Delta T$
	$+78.1$	$+0.190 - 2.63\delta a + 4.87\delta c + \delta\Delta T$	0.4	$+0.047$	$+0.076 - 1.05\delta a + 1.95\delta c + 0.40\delta\Delta T$
	$+77.3$ L.C.	$+0.040 + 3.82\delta a - 4.55\delta c + \delta\Delta T$	0.3	$+0.014$	$+0.012 + 1.15\delta a - 1.36\delta c + 0.30\delta\Delta T$
				For L. W. only.	
Lamp West.	-19.2	$0 = +0.153 + 0.97\delta a - 1.09\delta c + \delta\Delta T$	1.6	$+0.272$	$0 = +0.245 + 1.55\delta a - 1.74\delta c + 1.60\delta\Delta T$
	$+23.7$	$-0.053 + 0.40\delta a - 1.10\delta c + \delta\Delta T$	1.7	-0.017	$-0.090 + 0.68\delta a - 1.87\delta c + 1.70\delta\Delta T$
	$+49.4$	$-0.165 - 0.13\delta a - 1.58\delta c + \delta\Delta T$	1.8	-0.216	$-0.297 - 0.23\delta a - 2.84\delta c + 1.80\delta\Delta T$
	$+79.1$ L.C.	$+0.030 + 4.35\delta a + 5.29\delta c + \delta\Delta T$	0.3	$+0.042$	$+0.009 + 1.30\delta a + 1.59\delta c + 0.30\delta\Delta T$
	$+75.0$ L.C.	$+0.130 + 3.32\delta a + 3.86\delta c + \delta\Delta T$	0.4	$+0.088$	$+0.052 + 1.33\delta a + 1.54\delta c + 0.40\delta\Delta T$
	$+72.2$	$-0.160 - 1.47\delta a - 3.27\delta c + \delta\Delta T$	0.6	-0.072	$-0.096 - 0.88\delta a - 1.96\delta c + 0.60\delta\Delta T$
	$+86.6$	$+0.200 - 11.15\delta a - 16.86\delta c + \delta\Delta T$	0.1	$+0.014$	$+0.020 - 1.12\delta a - 1.69\delta c + 0.10\delta\Delta T$
	$+69.4$ L.C.	$-0.180 + 2.57\delta a + 2.84\delta c + \delta\Delta T$	0.5	-0.040	$-0.090 + 1.28\delta a + 1.42\delta c + 0.50\delta\Delta T$

Normal Equations.

Assume: $\Delta T_0 = +\overset{s.}{6.570}$; $c_0 = -\overset{s.}{0.010}$; $a_0 = -\overset{s.}{0.450}$.

Without weights. L. E. and L. W.

$$\begin{array}{rrrrr} 0 = & -\overset{s.}{1.810} & +190.12\delta a & +198.98\delta c & -0.43\delta\Delta T \\ & -1.765 & +198.98\delta a & +411.80\delta c & -5.64\delta\Delta T \\ & +0.369 & -0.43\delta a & -5.64\delta c & +13.00\delta\Delta T \end{array}$$

$$0 = -0.078 - 2.709\delta\Delta T$$

$$\delta\Delta T = -\overset{s.}{0.029}; \quad \delta c = -\overset{s.}{0.002}; \quad \delta a = +\overset{s.}{0.012}.$$

With weights. L. E. and L. W.

$$\begin{array}{rrrrr} 0 = & +\overset{s.}{0.959} & +16.59\delta a & +5.89\delta c & +8.37\delta\Delta T \\ & +1.800 & +5.89\delta a & +47.53\delta c & -0.12\delta\Delta T \\ & +0.613 & +8.37\delta a & -0.12\delta c & +18.38\delta\Delta T \end{array}$$

$$0 = -0.0033 - 0.2062\delta\Delta T$$

$$\delta\Delta T = -\overset{s.}{0.016}; \quad \delta c = -\overset{s.}{0.033}; \quad \delta a = -\overset{s.}{0.038}.$$

With weights. L. E. only.

$$\Delta T_0 = +\overset{s.}{6.638}; \quad c_0 = -\overset{s.}{0.137}; \quad a_0 = -\overset{s.}{0.581}.$$

$$\begin{array}{rrrrr} 0 = & -\overset{s.}{0.007} & +6.56\delta a & -0.34\delta c & +4.22\delta\Delta T \\ & -0.035 & -0.34\delta a & +19.31\delta c & +10.49\delta\Delta T \\ & -0.003 & +4.22\delta a & +10.49\delta c & +8.82\delta\Delta T \end{array}$$

$$0 = -0.00007 - 0.0119\delta\Delta T$$

$$\delta\Delta T = -\overset{s.}{0.006}; \quad \delta c = +\overset{s.}{0.006}; \quad \delta a = +\overset{s.}{0.007}.$$

With weights. L. W. only.

$$\Delta T_0 = +\overset{s.}{6.670}; \quad c_0 = \overset{s.}{0.000}; \quad a_0 = -\overset{s.}{0.496}.$$

$$\begin{array}{rrrrr} 0 = & +\overset{s.}{0.628} & +10.03\delta a & +6.23\delta c & +4.15\delta\Delta T \\ & +0.435 & +6.23\delta a & +28.22\delta c & -10.61\delta\Delta T \\ & +0.003 & +4.15\delta a & -10.61\delta c & +9.56\delta\Delta T \end{array}$$

$$0 = +0.0080 - 0.0238\delta\Delta T$$

$$\delta\Delta T = +\overset{s.}{0.336}; \quad \delta c = +\overset{s.}{0.180}; \quad \delta a = -\overset{s.}{0.314}.$$

Solution for $\delta c = 0$.

Without weights. L. E. and L. W.

$$0 = +0.848 + 30.231\delta\Delta T$$

$$\delta\Delta T = -\overset{s.}{0.028}; \quad \delta c = \overset{s.}{0.000}; \quad \delta a = +\overset{s.}{0.011}.$$

With weights. L. E. and L. W.

$$0 = +0.015 + 1.691\delta\Delta T$$

$$\delta\Delta T = -\overset{s.}{0.009}; \quad \delta c = \overset{s.}{0.000}; \quad \delta a = -\overset{s.}{0.053}.$$

With weights. L. E. only.

$$0 = +0.0004 + 1.4467\delta\Delta T$$

$$\delta\Delta T = \overset{s.}{0.000}; \quad \delta c = \overset{s.}{0.000}; \quad \delta a = +\overset{s.}{0.001}.$$

With weights. L. W. only.

$$0 = -0.0619 + 1.8898\delta\Delta T$$

$$\delta\Delta T = +\overset{s.}{0.033}; \quad \delta c = \overset{s.}{0.000}; \quad \delta a = -\overset{s.}{0.076}.$$

June 23, 1883.

Fundamental Equations.

Position.	δ.	Without weights.	Weight factor $= w$.	With weights.
	°	s.		s.
Lamp East.	−12.1	$0 = +0.078 +0.88\delta a +1.04\delta c +\delta\Delta T$	2.1	$0 = +0.164 +1.85\delta a +2.18\delta c +2.10\delta\Delta T$
	+18.3	$+0.060 +0.48\delta a +1.07\delta c +\delta\Delta T$	2.6	$+0.156 +1.25\delta a +2.78\delta c +2.60\delta\Delta T$
	+38.4	$-0.149 +0.01\delta a +1.43\delta c +\delta\Delta T$	2.4	$0.358 +0.02\delta a +3.43\delta c +2.40\delta\Delta T$
	+72.3 L. C.	$+0.116 +2.91\delta a -3.29\delta c +\delta\Delta T$	0.4	$+0.046 +1.16\delta a -1.32\delta c +0.40\delta\Delta T$
	+74.6	$+0.296 -1.84\delta a +3.77\delta c +\delta\Delta T$	0.5	$+0.148 -0.92\delta a +1.88\delta c +0.50\delta\Delta T$
	+77.3 L. C.	$+0.346 +3.82\delta a -4.55\delta c +\delta\Delta T$	0.3	$+0.104 +1.15\delta a -1.36\delta c +0.30\delta\Delta T$
	+72.3	$+0.006 -1.48\delta a +3.28\delta c +\delta\Delta T$	0.6	$+0.004 -0.89\delta a +1.97\delta c +0.60\delta\Delta T$
	+78.1	$+0.246 -2.63\delta a +4.87\delta c +\delta\Delta T$	0.4	$+0.098 -1.05\delta a +1.95\delta c +0.40\delta\Delta T$
Lamp West.	− 9.6	$0 = +0.050 +0.83\delta a -1.03\delta c +\delta\Delta T$	2.5	$0 = +0.125 +2.08\delta a -2.58\delta c +2.50\delta\Delta T$
	+24.5	$-0.094 +0.34\delta a -1.19\delta c +\delta\Delta T$	1.7	$-0.160 +0.58\delta a -2.02\delta c +1.70\delta\Delta T$
	+62.1	$-0.184 -0.62\delta a -2.14\delta c +\delta\Delta T$	0.8	$-0.147 -0.50\delta a -1.71\delta c +0.80\delta\Delta T$
	+70.1	$+0.036 -1.22\delta a -2.93\delta c +\delta\Delta T$	0.6	$+0.022 -0.73\delta a -1.76\delta c +0.60\delta\Delta T$
	+70.8	$-0.054 -1.30\delta a -3.04\delta c +\delta\Delta T$	0.6	$-0.032 -0.78\delta a -1.82\delta c +0.60\delta\Delta T$
	+73.1	$+0.076 -1.60\delta a -3.45\delta c +\delta\Delta T$	0.5	$+0.038 -0.80\delta a -1.72\delta c +0.50\delta\Delta T$

Normal Equations.

Assume: $\delta T_0 = +6\overset{s}{.}886\,;\ c_0 = -0\overset{s}{.}060\,;\ a_0 = -0\overset{s}{.}340.$

Without weights. L. E. and L. W.

$$\begin{aligned} 0 &= +0\overset{s}{.}583 +43.50\delta a -36.99\delta c -1.42\delta\Delta T\\ & +0.561 -36.99\delta a +121.25\delta c -6.16\delta\Delta T\\ & +0.829 -1.42\delta a -6.16\delta c +14.00\delta\Delta T \end{aligned}$$

$$0 = +0.091 +1.234\delta\Delta T$$

$$\delta\Delta T = -0\overset{s}{.}074\,;\quad \delta c = -0\overset{s}{.}018\,;\quad \delta a = -0\overset{s}{.}030.$$

With weights. L. E. and L. W.

$$\begin{aligned} 0 &= +0\overset{s}{.}641 +17.09\delta a -2.65\delta c +11.05\delta\Delta T\\ & +0.045 -2.65\delta a +62.07\delta c +7.74\delta\Delta T\\ & -0.010 +11.05\delta a +7.74\delta c +28.70\delta\Delta T \end{aligned}$$

$$0 = +0.0016 -0.0714\delta\Delta T$$

$$\delta\Delta T = +0\overset{s}{.}022\,;\quad \delta c = -0\overset{s}{.}006\,;\quad \delta a = -0\overset{s}{.}053.$$

With weights. L. E. only.

$$\begin{aligned} 0 &= +0\overset{s}{.}421 +10.39\delta a -1.05\delta c +6.57\delta\Delta T\\ & -0.161 -1.05\delta a +39.04\delta c +22.00\delta\Delta T\\ & +0.055 +6.57\delta a +22.00\delta c +17.95\delta\Delta T \end{aligned}$$

$$0 = +0.0006 -0.0022\delta\Delta T$$

$$\delta\Delta T = +0\overset{s}{.}273\,;\quad \delta c = -0\overset{s}{.}156\,;\quad \delta a = -0\overset{s}{.}229.$$

With weights. L. W. only.

$$\begin{aligned} 0 &= +0\overset{s}{.}220 +6.70\delta a -1.60\delta c +4.48\delta\Delta T\\ & +0.206 -1.60\delta a +23.03\delta c -14.26\delta\Delta T\\ & -0.065 +4.48\delta a -14.26\delta c +10.75\delta\Delta T \end{aligned}$$

$$0 = +0.00122 -0.00145\delta\Delta T$$

$$\delta\Delta T = +0\overset{s}{.}841\,;\quad \delta c = +0\overset{s}{.}479\,;\quad \delta a = -0\overset{s}{.}481.$$

Solution for $\delta c = 0$.

Without weights. L. E. and L. W.

$$0 = +0.597 +9.826\delta\Delta T$$

$$\delta\Delta T = -0\overset{s}{.}064\,;\quad \delta c = 0\overset{s}{.}000\,;\quad \delta a = -0\overset{s}{.}015.$$

With weights. L. E. and L. W.

$$0 = +0.0384 -1.9507\delta\Delta T$$

$$\delta\Delta T = +0\overset{s}{.}020\,;\quad \delta c = 0\overset{s}{.}000\,;\quad \delta a = -0\overset{s}{.}050.$$

With weights. L. E. only.

$$0 = +0.0321 -2.0998\delta\Delta T$$

$$\delta\Delta T = +0\overset{s}{.}015\,;\quad \delta c = 0\overset{s}{.}000\,;\quad \delta a = -0\overset{s}{.}050.$$

With weights. L. W. only.

$$0 = +0.0473 +1.7309\delta\Delta T$$

$$\delta\Delta T = -0\overset{s}{.}027\,;\quad \delta c = 0\overset{s}{.}000\,;\quad \delta a = -0\overset{s}{.}015.$$

Residuals Derived from the Various Solutions.

The residuals given on the following pages have been obtained by substituting in the equations given on page 145–151 the values of ΔT, a, and c, derived from the various solutions. The residuals wv are given for all the solutions in which the weight factors have been applied.

Position.	Sidereal time.	Declination.	Without weights.			With weights.											
			C. E. and C. W. First Solution	C. E. and C. W.	C. E. and C. W. $\delta c = 0$.	C. E. and C. W.		C. E. only.		C. W. only.		C. E. and C. W. $\delta c = 0$.		C. E. only. $\delta c = 0$.		C. W. only. $\delta c = 0$.	
	a.	δ.	v.	v.	v.	v.	wv.	v.	wv.	v.	wv.	v.	wv.	v.	wv.	v.	wv.
			June 1, 1883.														
			$a=+0.38$ $c=+0.20$ $\Delta T=-14.970$	$a=+0.305$ $c=+0.217$ $\Delta T=-14.916$	$a=+0.376$ $c=+0.2[illegible]0$ $\Delta T=-14.930$	$a=+0.355$ $c=+0.215$ $\Delta T=-14.949$		$a=+0.179$ $c=+0.086$ $\Delta T=-14.746$		$a=+0.393$ $c=+0.200$ $\Delta T=-14.970$		$a=+0.353$ $c=+0.200$ $\Delta T=-14.954$		$a=+0.313$ $c=+0.200$ $\Delta T=-14.930$		$a=+0.393$ $c=+0.200$ $\Delta T=-14.968$	
	h.	°	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.
Circle East.	12.8	+4.0	+0.02	+0.10	+0.05	+0.04	+0.04	+0.00	+0.00			+0.01	+0.01	+0.01	+0.01		
	12.9	+11.6	+0.02	+0.10	+0.05	+0.05	+0.05	+0.03	+0.03			+0.02	+0.02	+0.03	+0.03		
	12.4	+70.4	−0.23	−0.15	−0.19	−0.13	−0.08	−0.07	−0.04			−0.18	−0.11	−0.10	−0.06		
	12.9	+94.4	−0.02	−0.03	−0.02	−0.45	−0.06	−0.37	−0.05			−0.28	−0.04	−0.67	−0.09		
Circle West.	13.3	−10.5	+0.01	+0.05	+0.04	−0.01	−0.01			+0.01	+0.01	+0.00	+0.00			+0.02	+0.02
	13.1	+28.5	−0.06	−0.02	−0.02	−0.06	−0.06			−0.05	−0.05	−0.05	−0.05			−0.05	−0.05
	13.5	+37.8	−0.02	+0.06	+0.07	+0.02	+0.02			+0.03	+0.03	+0.04	+0.04			+0.03	+0.03
	13.3	+73.0	+0.04	+0.01	+0.09	+0.05	+0.03			+0.01	+0.01	+0.10	+0.06			+0.01	+0.01
			June 2, 1883.														
			$a=+0.507$ $c=-0.176$ $\Delta T=-14.325$	$a=+0.500$ $c=-0.176$ $\Delta T=-14.302$	$a=+0.510$ $c=-0.176$ $\Delta T=-14.356$	$a=+0.548$ $c=-0.214$ $\Delta T=-14.351$		$a=+0.544$ $c=-0.200$ $\Delta T=-14.314$		$a=+0.683$ $c=-0.076$ $\Delta T=-14.545$		$a=+0.518$ $c=-0.176$ $\Delta T=-14.340$		$a=+0.652$ $c=-0.280$ $\Delta T=-14.432$		$a=+0.530$ $c=-0.189$ $\Delta T=-14.369$	
	h.	°	s.	s.	s.	s.	s.			s.	s.	s.	s.			s.	s.
Circle West.	13.2	−22.6	+0.02	+0.03	−0.02	−0.01	−0.01			+0.07	+0.06	+0.01	+0.01			−0.02	−0.02
	12.9	+11.6	+0.01	+0.04	−0.01	−0.02	−0.02			−0.01	−0.01	+0.01	+0.01			−0.03	−0.03
	13.1	+28.5	−0.07	−0.06	−0.11	−0.14	−0.14			−0.14	−0.14	−0.09	−0.09			−0.13	−0.13
	13.8	+19.0	+0.00	+0.03	−0.02	−0.04	−0.04			−0.03	−0.03	+0.00	+0.00			−0.03	−0.03
	12.8	+56.6	+0.22	+0.24	+0.18	+0.11	+0.09			+0.10	+0.08	+0.19	+0.16			+0.13	+0.11
	13.7	+49.9	+0.11	+0.13	+0.08	+0.12	+0.11			+0.01	+0.01	−0.01	−0.01			+0.04	+0.04
	13.9	+108.2	+0.05	+0.06	+0.03	+0.27	+0.11			+0.13	+0.05	+0.07	+0.03			+0.12	+0.05
Circle East.	14.1	−9.7	−0.10	−0.08	−0.13	−0.06	−0.06			−0.04	−0.04	−0.11	−0.11			+0.01	+0.01
	14.7	+2.4	−0.03	−0.02	+0.06	+0.00	+0.00			+0.02	+0.02	−0.04	−0.04			+0.05	+0.05
	14.7	−15.5	+0.00	+0.02	+0.03	+0.05	+0.05			+0.07	+0.07	+0.00	+0.00			+0.13	+0.12
	14.2	+46.6	−0.15	−0.14	−0.18	−0.13	−0.12			−0.11	−0.10	−0.17	−0.16			−0.13	−0.12
	14.4	+59.8	−0.22	−0.19	−0.25	−0.09	−0.07			−0.18	−0.15	−0.24	−0.20			−0.20	−0.16
	16.4	+21.7	+0.00	+0.02	−0.03	+0.03	+0.03			+0.05	+0.05	−0.01	−0.01			+0.06	+0.06
	16.6	+39.1	−0.17	−0.15	−0.20	−0.15	−0.14			−0.13	−0.12	−0.19	−0.18			−0.23	−0.22
	16.7	+57.0	−0.07	−0.05	−0.11	−0.05	−0.04			−0.03	−0.02	−0.19	−0.16			−0.05	−0.04
	13.9	+108.2	−0.01	+0.00	−0.02	−0.03	−0.01			+0.04	+0.02	+0.01	+0.00			−0.02	−0.01
	14.0	+64.9	+0.06	+0.08	+0.02	+0.08	+0.06			+0.09	+0.07	+0.03	+0.02			+0.06	+0.04
	14.2	+78.1	+0.01	+0.06	−0.03	+0.06	+0.02			+0.04	+0.02	−0.03	−0.01			+0.00	+0.00
	14.3	+113.1	+0.26	+0.26	+0.15	+0.23	+0.11			+0.29	+0.14	+0.26	+0.13			+0.23	+0.12
	15.1	+102.7	+0.08	+0.08	+0.07	+0.05	+0.02			+0.13	+0.04	+0.11	+0.04			+0.08	+0.03
	16.5	+69.0	+0.24	+0.26	+0.20	+0.26	+0.17			+0.26	+0.17	+0.20	+0.13			+0.23	+0.15
	16.5	+104.3	−0.16	−0.17	−0.18	−0.20	−0.07			−0.12	−0.04	−0.14	−0.05			−0.18	−0.06
Circle West.	17.1	+14.5	+0.02	+0.03	−0.02	−0.04	−0.04					+0.00	+0.00				
	17.5	+52.4	+0.28	+0.31	+0.25	+0.18	+0.16					+0.27	+0.24				
	17.5	+12.6	+0.15	+0.17	+0.12	+0.11	+0.11					+0.14	+0.14				

Residuals Derived from the Various Solutions. — *Continued.*

Position.	Sidereal time.	Declination.	Without weights.			With weights.											
			C. E. and C. W.	C. E. and C. W.	C. E. and C. W.	C. E. and C. W.		C. E. only.		C. W. only.		C. E. and C. W.		C. E. only.		C. W. only.	
			First Solution.		$\delta c = 0$.							$\delta c = 0$.		$\delta c = 0$.		$\delta c = 0$.	
	a.	δ.	v.	v.	v.	v.	wv.	v.	wv.	v.	wv.	v.	wv.	v.	wv.	v.	wv.
								June 4, 1883.									
			$a=+0.89$ $c=+0.26$ $\Delta T=-13.375$	$a=+0.907$ $c=+0.263$ $\Delta T=-13.379$	$a=+0.900$ $c=+0.260$ $\Delta T=-13.382$	$a=+0.889$ $c=+0.272$ $\Delta T=-13.375$		$a=+0.811$ $c=+0.206$ $\Delta T=-13.265$		$a=+1.070$ $c=+0.096$ $\Delta T=-13.681$		$a=+0.897$ $c=+0.260$ $\Delta T=-13.397$		$a=+0.880$ $c=+0.260$ $\Delta T=-13.349$		$a=+0.895$ $c=+0.260$ $\Delta T=-13.406$	
	h.	°	s.	s.	s.	s.	s.	s.	s.			s.	s.	s.	s.		
Circle East.	13.2	− 22.6	+0.00	+0.01	+0.00	+0.01	+0.01	−0.03	−0.03			−0.02	−0.02	+0.01	+0.01		
	13.3	− 10.5	−0.05	−0.05	−0.05	−0.05	−0.05	−0.07	−0.07			−0.07	−0.07	−0.01	−0.04		
	12.9	+ 11.6	+0.02	+0.02	+0.02	+0.02	+0.02	+0.03	+0.03			−0.01	−0.01	+0.04	+0.04		
	13.1	+ 28.5	+0.05	+0.06	+0.05	+0.07	+0.07	+0.08	+0.08			+0.03	+0.03	+0.07	+0.07		
	13.8	+ 19.0	−0.06	−0.07	−0.06	−0.05	−0.05	−0.04	−0.04			−0.09	−0.09	−0.04	−0.04		
	12.8	+ 56.6	−0.08	−0.09	−0.10	−0.06	−0.05	−0.04	−0.03			−0.11	−0.09	−0.05	−0.04		
	13.7	+ 49.9	−0.08	−0.07	−0.08	−0.05	−0.05	−0.03	−0.03			−0.09	−0.08	−0.04	−0.04		
	14.0	+ 64.9	−0.11	−0.12	−0.13	−0.08	−0.06	−0.06	−0.04			−0.14	−0.10	−0.08	−0.06		
	16.6	+ 39.1	+0.04	+0.03	+0.03	+0.05	+0.05	+0.07	+0.07			+0.01	+0.01	+0.06	+0.06		
	16.9	+ 9.5	−0.03	−0.01	−0.03	−0.01	−0.01	−0.01	−0.01			−0.04	−0.04	+0.00	+0.00		
	17.1	+ 14.5	+0.04	+0.04	+0.03	+0.04	+0.04	+0.05	+0.05			−0.01	+0.01	+0.05	+0.05		
	13.4	+ 73.0	−0.00	−0.03	−0.03	+0.04	+0.02	+0.06	+0.03			−0.04	−0.02	+0.04	+0.02		
	13.4	+107.5	−0.04	+0.24	−0.03	+0.16	+0.07	+0.25	+0.10			+0.20	+0.08	+0.20	+0.08		
	13.9	+108.1	−0.10	−0.08	−0.08	−0.15	−0.06	−0.06	−0.03			−0.11	−0.05	−0.12	−0.05		
	17.0	+100.9	−0.06	+0.01	−0.01	−0.11	−0.05	−0.01	−0.00			−0.04	−0.02	−0.06	−0.03		
Circle West.	14.1	− 9.7	+0.10	+0.10	+0.10	+0.08	+0.08	+0.10	+0.10			+0.08	+0.08	+0.07	+0.07		
	14.7	− 15.5	−0.14	−0.12	−0.13	−0.15	−0.14	−0.11	−0.10			−0.15	−0.14	−0.16	−0.15		
	15.9	− 22.3	+0.04	+0.05	+0.04	+0.02	+0.02	+0.08	+0.07			+0.02	+0.02	+0.01	+0.01		
	14.7	+ 2.5	+0.05	+0.06	+0.05	+0.04	+0.04	+0.03	+0.03			+0.04	+0.04	+0.03	+0.03		
	16.3	+ 19.4	+0.06	+0.07	+0.07	+0.06	+0.06	+0.02	+0.02			+0.06	+0.06	+0.04	+0.04		
	14.0	+ 61.9	+0.13	+0.09	+0.11	+0.09	+0.07	+0.01	+0.03			+0.09	+0.07	+0.08	+0.06		
	14.2	+ 46.6	+0.09	+0.09	+0.09	+0.08	+0.07	+0.01	+0.01			+0.07	+0.07	+0.07	+0.07		
	14.8	+ 59.8	+0.03	+0.01	+0.02	+0.01	+0.01	−0.05	−0.04			+0.01	+0.01	+0.00	+0.00		
	16.0	+ 58.9	−0.06	−0.08	−0.07	−0.08	−0.07	−0.14	−0.12			−0.08	−0.07	−0.09	−0.07		
	14.2	+ 78.1	+0.28	+0.22	+0.25	+0.23	+0.09	+0.27	+0.11			+0.24	+0.10	+0.24	+0.10		
	14.3	+113.1	+0.08	+0.27	+0.24	+0.25	+0.12	−0.07	−0.03			+0.22	+0.11	+0.20	+0.10		
	14.9	+ 74.6	−0.32	−0.37	−0.31	−0.36	−0.18	−0.36	−0.18			−0.35	−0.17	−0.35	−0.17		
	15.8	+ 78.2	+0.24	+0.18	+0.20	+0.19	+0.08	+0.22	+0.09			+0.20	+0.08	+0.20	+0.08		
	16.2	+ 76.2	−0.01	−0.06	−0.04	−0.05	−0.02	−0.05	−0.02			−0.04	−0.02	−0.05	−0.02		
								June 5, 1883.									
			$a=+1.20$ $c=+0.24$ $\Delta T=-13.059$	$a=+1.195$ $c=+0.248$ $\Delta T=-13.090$	$a=+1.195$ $c=+0.240$ $\Delta T=-13.082$	$a=+1.175$ $c=+0.266$ $\Delta T=-13.069$		$a=+0.996$ $c=+0.107$ $\Delta T=-12.811$		$a=+1.263$ $c=+0.185$ $\Delta T=-13.236$		$a=+1.181$ $c=+0.240$ $\Delta T=-13.064$		$a=+1.058$ $c=+0.160$ $\Delta T=-12.892$		$a=+1.421$ $c=+0.050$ $\Delta T=-13.439$	
	h.	°	s.	s.	s.	s.	s.	s.	s.			s.	s.	s.	s.		
Circle East.	13.2	− 22.6	+0.05	+0.03	+0.03	+0.05	+0.05	−0.04	−0.04			+0.03	+0.03	+0.00	+0.00		
	13.3	− 10.5	+0.09	+0.07	+0.07	+0.09	+0.09	+0.04	+0.04			+0.08	+0.08	+0.07	+0.07		
	12.9	+ 11.6	−0.05	−0.07	−0.07	−0.04	−0.04	−0.03	−0.03			−0.05	−0.05	−0.03	−0.03		
	13.1	+ 28.5	+0.01	−0.01	−0.02	+0.02	+0.02	+0.05	+0.05			+0.00	+0.00	+0.04	+0.04		
	13.8	+ 19.0	−0.01	−0.02	−0.03	+0.01	+0.01	+0.02	+0.02			−0.01	−0.01	+0.02	+0.02		
	13.9	+ 28.0	−0.04	−0.07	−0.07	−0.03	−0.03	+0.00	+0.00			−0.05	−0.05	−0.01	−0.01		
	12.8	+ 56.6	−0.25	−0.27	−0.28	−0.21	−0.18	−0.16	−0.14			−0.26	−0.22	−0.18	−0.15		
	13.7	+ 49.9	−0.18	−0.19	−0.20	−0.14	−0.13	−0.09	−0.08			−0.18	−0.16	−0.11	−0.10		
	14.0	+ 64.9	+0.03	+0.02	+0.01	+0.10	+0.07	+0.14	+0.10			+0.04	+0.03	+0.13	+0.09		

Residuals Derived from the Various Solutions. — *Continued.*

Position.	Sidereal time.	Declination.	Without weights.			With weights.											
			C. E. and C. W.	C. E. and C. W.	C. E. and C. W.	C. E. and C. W.		C. E. only.		W. only.		C. E. and C. W.		C. E. only.		C. W. only.	
			First Solution.		$\delta c = 0$.							$\delta c = 0$.		$\delta c = 0$.		$\delta c = 0$.	
	α.	δ.	r.	r.	r.	r.	wr.	r.	wr.	r.	wr.	r.	wr.	r.	wr.	r.	wr.
								June 5, 1883.									
			$a = +1.20$, $c = +0.24$, $\Delta T = -13.059$	$a = +1.195$, $c = +0.248$, $\Delta T = -13.090$	$a = +1.195$, $c = +0.240$, $\Delta T = -13.082$	$a = +1.175$, $c = +0.266$, $\Delta T = -13.069$		$a = +0.996$, $c = +0.107$, $\Delta T = -12.811$		$a = +1.263$, $c = +0.185$, $\Delta T = -13.236$		$a = +1.181$, $c = +0.240$, $\Delta T = -13.064$		$a = +1.058$, $c = +0.160$, $\Delta T = -12.892$		$a = +1.421$, $c = +0.050$, $\Delta T = -13.439$	
	h.	°	s.	s.	s.	s.	s.	s.	s.			s.	s.	s.	s.		
Circle East.	13.4	+ 73.0	−0.08	−0.08	−0.10	+0.04	+0.02	+0.06	+0.03			−0.06	−0.03	+0.05	+0.03		
	13.4	+107.5	+0.05	−0.01	+0.03	−0.10	−0.04	+0.14	+0.06			+0.00	+0.00	+0.07	+0.03		
	13.9	+108.1	−0.14	−0.20	−0.17	−0.30	−0.13	−0.06	−0.03			−0.19	−0.08	−0.13	−0.05		
	14.1	+ 78.1	−0.06	−0.04	−0.07	+0.13	+0.05	+0.12	+0.05			−0.01	−0.00	+0.12	+0.05		
Circle West.	15.9	− 22.3	+0.11	+0.07	+0.09	+0.06	+0.05	+0.06	+0.05			+0.09	+0.08	+0.16	+0.14		
	16.0	− 19.5	+0.05	+0.00	+0.02	−0.02	−0.02	−0.01	−0.01			+0.02	+0.02	+0.07	+0.06		
	16.4	+ 21.8	+0.09	+0.05	+0.06	+0.04	+0.04	−0.01	−0.01			+0.08	+0.08	+0.00	+0.00		
	14.8	+ 59.8	−0.02	−0.07	−0.05	−0.07	−0.06	−0.13	−0.11			−0.02	−0.02	−0.16	−0.13		
	16.0	+ 58.9	−0.03	−0.09	−0.06	−0.09	−0.07	−0.15	−0.12			−0.04	−0.03	−0.18	−0.15		
	16.4	+ 61.8	+0.15	+0.21	+0.23	+0.20	+0.16	+0.15	+0.12			+0.26	+0.20	+0.12	+0.09		
	14.2	+ 78.1	−0.18	−0.25	−0.19	−0.25	−0.10	−0.28	−0.11			−0.14	−0.06	−0.27	−0.11		
	14.3	+113.1	+0.06	+0.04	+0.03	+0.06	+0.03	−0.11	−0.06			+0.01	+0.00	−0.27	−0.13		
	14.4	+107.7	+0.20	+0.18	+0.16	+0.20	+0.08	+0.03	+0.01			+0.14	+0.06	−0.15	−0.06		
	14.8	+ 74.5	+0.36	+0.30	+0.45	+0.30	+0.15	+0.26	+0.13			+0.39	+0.19	+0.25	+0.12		
	15.8	+ 78.1	+0.17	+0.12	+0.16	+0.11	+0.04	+0.08	+0.03			+0.22	+0.09	+0.09	+0.04		
								June 17, 1883.									
			L. E. and L. W.	L. E. and L. W.	L. E. and L. W.	L. E. and L. W.		L. E. only.		L. W. only.		L. E. and L. W.		L. E. only.		L. W. only.	
			$a = -0.680$, $c = +0.310$, $\Delta T = +6.569$	$a = -0.684$, $c = +0.294$, $\Delta T = +6.578$	$a = -0.683$, $c = +0.310$, $\Delta T = +6.580$	$a = -0.680$, $c = +0.276$, $\Delta T = +6.571$		$a = -0.723$, $c = +0.277$, $\Delta T = +6.574$		$a = -0.693$, $c = +0.315$, $\Delta T = +6.643$		$a = -0.671$, $c = +0.310$, $\Delta T = +6.557$		$a = -0.681$, $c = +0.310$, $\Delta T = +6.519$		$a = -0.687$, $c = +0.310$, $\Delta T = +6.631$	
	h.	°	s.	s.	s.	s.	s.	s.	s.			s.	s.	s.	s.		
Lamp East.	15.4	+29.5	+0.12	+0.12	+0.14	+0.09	+0.09	+0.08	+0.08			+0.12	+0.12	+0.08	+0.08		
	15.5	+27.1	−0.06	−0.07	−0.05	−0.09	−0.09	−0.11	−0.11			−0.07	−0.07	−0.11	−0.11		
	15.6	+ 6.8	+0.01	+0.01	+0.03	−0.01	−0.01	−0.03	−0.03			+0.02	+0.02	−0.03	−0.03		
	15.7	+15.8	+0.10	+0.10	+0.11	+0.07	+0.07	+0.06	+0.06			+0.10	+0.10	+0.06	+0.06		
	15.7	+18.5	+0.04	+0.05	+0.06	+0.03	+0.03	+0.01	+0.01			+0.05	+0.05	+0.01	+0.01		
	15.8	+78.1	+0.04	−0.01	+0.07	−0.12	−0.05	+0.00	+0.00			+0.01	+0.00	+0.00	+0.00		
Lamp West.	16.0	−19.5	−0.06	−0.03	+0.05	−0.01	−0.01	+0.00	+0.00			−0.06	−0.06	+0.00	+0.00		
	16.1	− 3.6	−0.03	+0.00	−0.02	+0.01	+0.01	+0.03	+0.03			−0.03	−0.03	+0.03	+0.03		
	16.2	− 4.4	−0.11	−0.08	−0.10	−0.07	−0.07	−0.05	−0.05			−0.11	−0.11	−0.05	−0.05		
	16.2	+76.2	−0.09	+0.01	−0.06	+0.06	+0.03	+0.00	+0.00			−0.11	−0.05	+0.00	+0.00		
			L. E. only.					June 19, 1883.									
			$a = -0.650$, $c = +0.150$, $\Delta T = +6.500$	$a = -0.669$, $c = +0.139$, $\Delta T = +6.518$	$a = -0.654$, $c = +0.150$, $\Delta T = +6.505$			$a = -0.588$, $c = +0.194$, $\Delta T = +6.437$						$a = -0.646$, $c = +0.150$, $\Delta T = +6.505$			
	h.	°	s.	s.	s.			s.	s.					s.	s.		
Lamp East.	14.0	− 9.7	−0.03	−0.04	−0.03			+0.00	+0.00					−0.02	−0.02		
	14.7	+ 2.5	+0.01	+0.00	+0.01			+0.03	+0.03					+0.02	+0.02		
	15.4	+ 29.5	+0.00	+0.00	+0.01			+0.01	+0.01					+0.01	+0.01		
	15.5	+ 27.1	+0.01	+0.00	+0.01			+0.01	+0.01					+0.01	+0.01		
	14.8	+ 59.8	+0.00	+0.00	+0.00			−0.01	−0.01					+0.00	+0.00		
	14.0	+ 64.9	−0.02	+0.00	−0.01			−0.02	−0.01					−0.01	−0.01		
	14.3	+113.1	−0.07	−0.07	−0.07			−0.10	−0.05					−0.06	−0.03		
	14.8	+ 74.6	+0.04	+0.05	+0.05			+0.03	+0.02					+0.04	+0.02		
	15.1	+102.7	+0.07	+0.06	+0.06			+0.04	+0.01					+0.08	+0.03		
	15.2	+ 67.8	−0.04	−0.04	−0.03			−0.05	−0.04					−0.04	−0.03		

RESIDUALS DERIVED FROM THE VARIOUS SOLUTIONS. — *Continued.*

Position.	Sidereal time.	Declination.	Without weights.			With weights.											
			L. W. only.	L. W. only.	L. W. only.	L. E. and L. W.		L. E. only		L. W. only.		L. E. and L. W.		L. E. only.		L. W. only.	
			First Solution		$\delta c = 0.$							$\delta c = 0.$		$\delta c = 0.$		$\delta c = 0.$	
	$\alpha.$	$\delta.$	$v.$	$v.$	$v.$	$v.$	$wv.$	$v.$	$wv.$	$v.$	$wv.$	$v.$	$wv.$	$v.$	$wv.$	$v.$	$wv.$
			JUNE 20, 1883.														
			$a=-0.540$ $c=+0.050$ $\Delta T=+6.405$	$a=-0.542$ $c=+0.053$ $\Delta T=+6.419$	$a=-0.546$ $c=+0.050$ $\Delta T=+6.423$					$a=-0.496$ $c=+0.077$ $\Delta T=+6.367$						$a=-0.528$ $c=+0.050$ $\Delta T=+6.416$	
	h.	°	s.	s.	s.					s.	s.					s.	s.
Lamp West.	14.7	− 15.6	−0.01	+0.00	+0.00					+0.02	+0.02					+0.00	+0.00
	15.9	− 22.3	−0.05	−0.04	−0.04					−0.02	−0.02					−0.04	−0.04
	16.0	− 19.5	−0.04	−0.01	−0.02					+0.00	+0.00					−0.02	−0.02
	13.8	+ 19.0	+0.00	+0.02	+0.02					+0.02	+0.02					+0.02	+0.02
	15.7	+ 18.5	−0.04	−0.02	−0.03					−0.03	−0.03					−0.03	−0.03
	14.0	+ 64.9	+0.14	+0.15	+0.15					+0.12	+0.09					+0.14	+0.10
	14.1	+ 78.1	−0.08	−0.05	−0.05					−0.11	−0.04					−0.08	−0.03
	14.3	+113.1	−0.04	−0.04	−0.04					−0.05	−0.02					−0.03	−0.02
	15.8	+ 78.1	−0.07	−0.04	−0.04					−0.09	−0.04					−0.07	−0.03
			JUNE 21, 1883.														
			L. E. and L. W.	L. E. and L. W.	L. E. and L. W.												
			$a=-0.450$ $c=-0.040$ $\Delta T=+6.570$	$a=-0.438$ $c=-0.042$ $\Delta T=+6.541$	$a=-0.439$ $c=-0.040$ $\Delta T=+6.542$	$a=-0.488$ $c=-0.073$ $\Delta T=+6.554$		$a=-0.574$ $c=-0.131$ $\Delta T=+6.632$		$a=-0.810$ $c=+0.180$ $\Delta T=+7.006$		$a=-0.503$ $c=-0.040$ $\Delta T=+6.561$		$a=-0.580$ $c=-0.137$ $\Delta T=+6.638$		$a=-0.572$ $c=+0.000$ $\Delta T=+6.703$	
	h.	°	s.	s.	s.	s.	s	s.	s.			s	s.	s.	s.		
Lamp East.	14.7	− 15.6	+0.26	+0.24	+0.24	+0.17	+0.16	+0.11	+0.10			+0.20	+0.19	+0.11	+0.10		
	15.9	− 22.3	+0.02	+0.01	+0.01	−0.06	−0.05	−0.13	−0.12			−0.04	−0.04	−0.14	−0.12		
	16.0	− 19.7	+0.13	+0.11	+0.11	+0.04	+0.04	−0.03	−0.03			+0.07	+0.06	−0.03	−0.03		
	15.0	+ 40.8	−0.08	−0.11	−0.11	−0.15	−0.14	−0.15	−0.14			−0.10	−0.10	−0.16	−0.15		
	15.4	+ 29.5	+0.11	+0.08	+0.08	+0.04	+0.04	+0.03	+0.03			+0.08	+0.08	+0.02	+0.02		
	15.5	+ 27.1	+0.14	+0.11	+0.11	+0.07	+0.07	+0.05	+0.05			+0.11	+0.11	+0.05	+0.05		
	15.6	+ 6.8	+0.19	+0.16	+0.16	+0.11	+0.11	+0.08	+0.08			+0.14	+0.14	+0.08	+0.08		
	15.7	+ 15.8	+0.12	+0.09	+0.09	+0.04	+0.04	+0.02	+0.02			+0.08	+0.08	+0.01	+0.01		
	15.7	+ 18.5	+0.16	+0.14	+0.14	+0.09	+0.09	+0.07	+0.07			+0.13	+0.13	+0.07	+0.07		
	14.9	+ 74.6	−0.06	−0.12	−0.11	−0.13	−0.06	−0.12	−0.06			+0.03	+0.01	−0.12	−0.06		
	15.1	+102.7	+0.04	+0.07	+0.05	+0.03	+0.01	+0.05	+0.02			−0.17	−0.08	+0.05	+0.02		
	15.8	+ 78.1	+0.19	+0.11	+0.12	+0.10	+0.04	+0.12	+0.05			+0.31	+0.13	+0.12	+0.05		
Lamp West.	17.2	− 24.2	+0.21	+0.20	+0.19	+0.20	+0.18	+0.04	+0.04			+0.15	+0.13	+0.18	+0.13		
	18.0	− 30.4	+0.22	+0.22	+0.20	+0.21	+0.17	+0.00	+0.00			+0.16	+0.13	+0.18	+0.12		
	18.3	− 2.9	+0.03	+0.01	+0.01	+0.02	+0.02	−0.02	−0.02			−0.02	−0.02	+0.03	+0.00		
	17.2	+ 14.5	+0.03	+0.01	−0.09	+0.03	+0.03	+0.05	+0.05			+0.00	+0.00	+0.06	+0.02		
	17.7	+ 27.8	−0.13	−0.15	−0.16	−0.12	−0.12	−0.06	−0.06			−0.15	−0.15	−0.08	−0.13		
	18.0	+ 28.8	−0.06	−0.08	−0.08	−0.05	−0.05	+0.01	+0.01			−0.08	−0.08	−0.01	−0.05		
	17.2	+ 36.9	−0.05	−0.07	−0.07	−0.03	−0.03	+0.05	+0.05			−0.06	−0.06	+0.01	−0.03		
	17.4	+ 52.4	−0.15	−0.17	−0.18	−0.10	−0.09	+0.00	+0.00			−0.14	−0.12	−0.05	−0.10		
	17.8	+ 56.9	−0.22	−0.25	−0.26	−0.16	−0.14	−0.06	−0.05			−0.21	−0.18	−0.12	−0.15		
	17.9	+ 51.5	−0.24	−0.27	−0.27	−0.20	−0.18	−0.10	−0.09			−0.24	−0.22	−0.15	−0.19		
	17.1	+100.9	+0.03	+0.04	+0.05	−0.33	−0.16	+0.06	+0.03			−0.21	−0.10	−0.15	−0.06		
	17.4	+105.0	+0.13	+0.12	+0.13	−0.18	−0.07	+0.21	+0.08			−0.06	−0.02	+0.00	+0.01		
	17.7	+ 72.2	−0.16	−0.20	−0.20	−0.01	−0.01	+0.09	+0.05			−0.09	−0.05	+0.02	−0.03		
	18.2	+ 86.6	+0.20	+0.07	+0.05	+1.16	+0.12	+0.94	+0.09			+0.78	+0.08	+1.02	+0.07		
	18.5	+110.6	−0.18	−0.18	−0.14	−0.39	−0.18	−0.05	−0.02			−0.33	−0.15	−0.25	−0.11		

Residuals Derived from the Various Solutions. — *Continued.*

Position.	Sidereal time.	Declination.	Without weights.			With weights.											
			L.E. and L.W.	L.E. and L.W.	L.E. and L.W.	L. E. and L.W.		L. E. only.		L. W. only.		L. E. and L. W.		L. E. only.		L. W. only.	
			First Solution		$\delta c = 0.$							$\delta c = 0.$		$\delta c = 0.$		$\delta c = 0.$	
	$\alpha.$	$\delta.$	$v.$	$v.$	$v.$	$v.$	$wv.$	$v.$	$wv.$	$v.$	$wv.$	$v.$	$wv.$	$v.$	$wv.$	$v.$	$wv.$
June 23, 1883.																	
			$a = -0.340$ $c = -0.060$ $\Delta T = +6.886$	$a = -0.078$ $c = -0.370$ $\Delta T = +6.812$	$a = -0.355$ $c = -0.060$ $\Delta T = +6.822$	$a = -0.393$ $c = -0.066$ $\Delta T = +6.908$		$a = -0.569$ $c = -0.216$ $\Delta T = +7.159$		$a = -0.821$ $c = +0.419$ $\Delta T = +7.727$		$a = -0.390$ $c = -0.060$ $\Delta T = +6.906$		$a = -0.390$ $c = -0.060$ $\Delta T = +6.901$		$a = -0.355$ $c = -0.060$ $\Delta T = +6\ 859$	
	h.	°	s.	s.	s.	s.	s.	s.	s.			s.	s.	s.	s.		
Lamp East.	14.1	− 9.7	+0.02	−0.10	−0.06	−0.02	−0.02	−0.06	−0.06			−0.01	−0.01	−0.01	−0.01		
	14.7	+ 2.4	+0.13	+0.01	+0.05	+0.10	+0.10	+0.09	+0.09			+0 11	+0.11	+0.11	+0.11		
	14.7	− 11.5	+0.03	−0.09	−0.04	+0.00	+0.00	−0.06	−0.06			+0.01	+0.01	+0.00	+0.00		
	15.9	− 22.3	+0.05	−0.08	−0.03	+0.00	+0.00	−0.08	−0.07			+0.01	+0.01	+0.01	+0.01		
	16.0	− 19.5	+0.16	+0.04	+0.09	+0.13	+0.12	+0.05	+0.05			+0.14	+0.13	+0.13	+0.12		
	15.4	+ 29.5	+0.00	−0.11	−0.07	+0.00	+0.00	+0.02	+0.02			+0.00	+0 00	+0.00	+0.00		
	15.5	+ 27.1	−0.11	−0.21	−0.17	−0.11	−0.11	−0.09	−0.09			−0.10	−0.10	−0.11	−0.11		
	15.6	+ 6.8	+0.19	+0.07	+0.11	+0.16	+0.16	+0.15	+0.15			+0.17	+0.17	+0.16	+0.16		
	15.7	+ 15.8	+0.17	+0.07	+0.11	+0.16	+0.16	+0.17	+0.17			+0.17	+0.17	+0.17	+0.17		
	15.7	+ 18.5	+0.17	+0.06	+0.10	+0.16	+0 16	+0.17	+0.17			+0.16	+0.16	+0.16	+0.16		
	18.3	+ 21.7	+0.04	−0.08	−0.03	+0.02	+0.02	+0.03	+0.03			+0.03	+0.03	+0.02	+0.02		
	19.8	+ 8.6	−0.04	−0.16	−0.11	−0.06	−0.06	−0 07	−0.07			−0.05	−0.05	−0.06	−0 06		
	14.9	+ 40.9	−0.33	−0.43	−0.40	−0.32	−0.31	−0.29	−0.28			−0.32	−0.31	−0.32	−0.31		
	15.4	+ 41.2	+0.04	−0.07	−0.03	+0.04	+0.04	+0.07	+0.07			+0.05	+0.05	+0.04	+0.04		
	17.9	+ 56.9	−0.17	−0.29	−0.22	−0.16	−0.14	−0.12	−0.10			−0.15	−0.13	−0.16	−0 14		
	17.9	+ 51.5	−0.03	−0.13	−0.10	−0.01	−0.01	+0.03	+0.03			+0.00	+0.00	−0.01	−0.01		
	18.5	+ 38.7	−0.29	−0.38	−0.35	−0.27	−0.26	−0.24	−0.23			−0.27	−0.26	−0.27	−0.26		
	18.7	+ 33.2	−0.11	−0.22	−0.19	−0 12	−0.12	−0.09	−0.09			−0.11	−0.11	−0.12	−0.12		
	14.4	+107.7	+0.12	+0.01	+0.01	+0 00	+0.00	+0.23	+0.09			−0.01	−0.01	−0.02	−0.01		
	14.8	+ 74.6	+0.30	+0.21	+0.26	+0.39	+0.19	+0.40	+0.20			+0.41	+0.20	+0.40	+0.20		
	15.1	+102.7	+0.35	+0.24	+0.23	+0.20	+0.06	+0.46	+0.14			+0.18	+0.06	+0.17	+0.06		
	15.3	+ 72.3	+0.01	−0.08	−0.03	+0.09	+0.05	+0.11	+0.06			+0.11	+0.06	+0.10	+0.06		
	15.8	+ 78.1	+0.25	+0.16	+0.23	+0.38	+0.16	+0.36	+0.15			+0.40	+0.16	+0.39	+0.16		
Lamp West.	21.4	− 6.1	+0.05	−0 03	−0.03	+0.03	+0.03	+0 02	+0.02			+0.03	+0.03	+0.01	+0.01		
	21.5	− 8.4	+0.02	−0.06	−0.06	+0.00	+0.00	−0.02	−0.02			+0.00	+0.00	−0 02	−0.02		
	21.8	− 14.1	+0.07	+0.00	+0.00	+0.06	+0.06	+0.02	+0.02			+0.06	+0.06	+0.04	+0.04		
	22 0	− 0.9	−0.03	−0.12	−0.11	−0.05	−0.05	−0.02	−0.02			−0.06	−0.06	−0.08	−0.08		
	22.2	− 8.2	+0.09	+0.01	+0.01	+0.07	+0.07	+0.05	+0.05			+0.07	+0.07	+0.05	+0.05		
	22.3	+ 0 8	+0.05	−0.02	−0.02	+0.05	+0.05	+0.08	+0.08			+0.04	+0.04	+0.02	+0.02		
	22.9	− 30.2	+0.11	+0.12	+0.02	+0.07	+0.06	−0.15	−0.12			+0.07	+0.06	+0.06	+0.05		
	21.7	+ 48.8	−0.19	−0.24	−0.26	−0.16	−0.15	−0.04	−0.04			−0.17	−0.15	−0.22	−0.20		
	22.6	+ 10.2	−0.17	−0.25	−0.25	−0.18	−0.18	−0.10	−0.10			−0.18	−0.18	−0.21	−0.21		
	23.0	+ 14.6	+0.08	+0.02	+0.01	+0.09	+0.09	+0.18	+0.18			+0.08	+0.08	+0.05	+0.05		
	21.3	+ 62.1	−0.18	−0.20	−0.24	−0.12	−0.09	−0.07	−0.06			−0.13	−0.10	−0.20	−0.16		
	21.5	+ 70.1	+0.04	+0.06	+0.00	+0.15	+0.10	+0.07	+0.04			+0.13	+0.08	+0.04	+0.03		
	21.7	+ 70.8	−0.05	−0.07	−0.14	+0.02	+0.01	−0.08	−0.05			+0.00	+0.00	−0.10	−0.06		
	21.9	+ 73.1	+0.08	+0 11	+0.04	+0.20	+0.11	+0.04	+0.02			+0.18	+0.10	+0.07	+0.04		

The greatest discordances among the values of the unknown quantities derived from the different solutions occur on June 23. On this date, however, the value of the collimation was most carefully determined before the commencement of the observations, and soon after sunrise the next morning, by reversal upon a ring of small diameter placed at the focus of a long collimator. Within the limits $\pm$ $0^s.04$ there can be no doubt whatever with regard to the value of this constant for the times at which the observations were made. Assuming that the value of c first determined remained constant until reversal, and that the morning value held true for the entire time after reversal, we have—

$$\text{For lamp east } c = -0^s.07$$
$$\text{For lamp west } c = -0.07$$

The equations between a and c are—

For Lamp East.

$0 = +0^s.11$	$+0.47a$	$-c$	For $c = -0^s.07$, $a = -0.38$
-0.20	$-1.00a$	$+c$	-0.27
$+0.17$	$+0.53a$	$-c$	-0.45
-0.33	$-1.05a$	$+c$	-0.38
-0.21	$-0.92a$	$+c$	-0.30
			Mean $= -0.36$

For Lamp West.

$0 = -0^s.72$	$-1.31a$	$-c$	For $c = -0^s.07$, $a = -0.50$
-0.43	$-1.08a$	$-c$	-0.33
-0.49	$-1.06a$	$-c$	-0.40
-0.39	$-1.00a$	$-c$	-0.32
			Mean $= -0.39$

For the determination of c from the observations for lamp east only, we have—

$$\text{From observations above pole, } 0 = -0^s.25 \quad -0.99a \quad +c$$
$$\text{From observations below pole, } 0 = +0.14 \quad +0.50a \quad -c$$

$$\text{Whence, } a = -0^s.22 \qquad c = +0^s.03$$

Combining the equations for lamp east and lamp west, we have—

For the Upper Culmination.

$$\text{Lamp East. } 0 = -0^s.25 \quad -0.99a \quad +c$$
$$\text{Lamp West. } 0 = -0.51 \quad -1.11a \quad -c$$
$$a = -0^s.36 \qquad c = -0^s.11$$

For the Lower Culmination.

$$0 = +0^s.14 \quad +0.50a \quad -c$$
$$0 = -0.51 \quad -1.11a \quad -c$$
$$a = -0^s.40 \qquad c = -0^s.06$$

It will be seen that the mean of the values for a and c are nearly identical with the values found by the least square solution, while the value of c differs but little from the value found by the mechanical determination.

With $c = -0^s.07$ and $a = -0^s.36$, the values of ΔT become—

$$\text{For lamp east } \Delta T = +6^s.875$$
$$\text{For lamp west } = +6.895$$
$$\text{Mean } = +6.885$$

It is not necessary to give the residuals, since they are nearly identical with those derived from the values, $c = -0^s.06$ and $a = -0^s.34$, as given on page 43.

We have in the observations on this date a clear illustration of the indeterminate character of the algebraical solution of the equations involving a, c, and ΔT, especially when there is no reversal of the instrument. As a further illustration, the following solution is given by equations (6):—

The fundamental equations, with weights as on page 56, and with the assumed values

$$\begin{aligned} a_0 &= -0^s.34 \\ c_0 &= -0.06 \\ \Delta T_0 &= +6.886 \end{aligned}$$

are as follows:—

For Lamp East.

$0 =$	$+0^s.164$	$+1.85\delta a$	$+0.00\delta a'$	$+2.18\delta c$	$+0.00\delta c'$	$+2.10\delta\Delta T$
	$+0.156$	$+1.25\delta a$	"	$+2.78\delta c$	"	$+2.60\delta\Delta T$
	-0.358	$+0.02\delta a$	"	$+3.43\delta c$	"	$+2.40\delta\Delta T$
	$+0.046$	$+1.16\delta a$	"	$-1.32\delta c$	"	$+0.40\delta\Delta T$
	$+0.148$	$-0.92\delta a$	"	$+1.88\delta c$	"	$+0.50\delta\Delta T$
	$+0.104$	$+1.15\delta a$	"	$-1.36\delta c$	"	$+0.30\delta\Delta T$
	$+0.004$	$-0.89\delta a$	"	$+1.97\delta c$	"	$+0.60\delta\Delta T$
	$+0.098$	$-1.05\delta a$	"	$+1.95\delta c$	"	$+0.40\delta\Delta T$

For Lamp West.

$0 =$	$+0^s.125$	$+0.00\delta a$	$+2.08\delta a'$	$+0.00\delta c$	$-2.58\delta c'$	$+2.50\delta\Delta T$
	-0.160	"	$+0.58\delta a'$	"	$-2.02\delta c'$	$+1.70\delta\Delta T$
	-0.147	"	$-0.50\delta a'$	"	$-1.71\delta c'$	$+0.80\delta\Delta T$
	$+0.022$	"	$-0.73\delta a'$	"	$-1.76\delta c'$	$+0.60\delta\Delta T$
	-0.032	"	$-0.78\delta a'$	"	$-1.82\delta c'$	$+0.60\delta\Delta T$
	$+0.038$	"	$-0.80\delta a'$	"	$-1.72\delta c'$	$+0.50\delta\Delta T$

The corresponding normal equations are—

$0 =$	$+0^s.4215$	$+10.396\delta a$	$+0.000\delta a'$	$-\ 1.048\delta c$	$+\ 0.000\delta c'$	$+\ 6.578\delta\Delta T$
	$+0.2192$	$+\ 0.000\delta a$	$+6.693\delta a'$	$+\ 0.000\delta c$	$-\ 1.602\delta c'$	$+\ 4.480\delta\Delta T$
	-0.1614	$-\ 1.048\delta a$	$+0.000\delta a'$	$+39.052\delta c$	$+\ 0.000\delta c'$	$+22.004\delta\Delta T$
	$+0.2058$	$+\ 0.000\delta a$	$-1.600\delta a'$	$+\ 0.000\delta c$	$+23.028\delta c'$	$-14.260\delta\Delta T$
	-0.0081	$+\ 6.578\delta a$	$+4.480\delta a'$	$+22.004\delta c$	$-14.260\delta c'$	$+28.700\delta\Delta T$

Whence—

$$\begin{aligned} \delta a &= -0^s.254 & a &= -0^s.647 \\ \delta a' &= -0.199 & a' &= -0.592 \\ \delta c &= -0.176 & c &= -0.242 \\ \delta c' &= +0.169 & c' &= +0.103 \\ \delta\Delta T &= +0.308 & \Delta T &= +7.216 \end{aligned}$$

With these values the residuals become—

For Lamp East.	For Lamp West.	For Lamp East.	For Lamp West.	For Lamp East.	For Lamp West.
s.	s.	s.	s.	s.	s.
−0.10	+0.01	+0.16		−0.23	+0.25
+0.06	−0.02	+0.16	−0.09	−0.08	
−0.10	+0.03	+0.03	−0.16		
−0.13	−0.05	−0.08	+0.12	+0.15	
+0.01	+0.05			+0.50	
		−0.27	−0.05	+0.63	
+0.02	+0.05	+0.09	+0.21	+0.20	
−0.09	−0.04	−0.08	+0.07	+0.50	
+0.13		+0.06			

It is obvious that on this date, as on several other dates, the solution by least squares fails to give the real values of the constants a and c when the equations are formed from the observations in one position of the instrument only, while the resulting residuals for ΔT remain to a great extent unchanged. This will be seen by an examination of the values of ΔT in the horizontal columns. Neither is there any gain in the form of solution by equations of the form (6).

Collection of Results for a, c, and ΔT. Cambridge Observations.

	June 1, 1883.			June 2, 1883.			June 4, 1883.			June 5, 1883.		
	a.	c.	ΔT.	a.	c.	ΔT.	a.	c.	ΔT.	a.	c.	ΔT.
From Solution for a, c, and ΔT.												
	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.
(1.) From Equations between a and c, C. E. and C. W.	+0.380	+0.200	−14.970	+0.507	−0.176	−14.325	+0.890	+0.258	−13.375	+1.200	+0.240	−13.059
(2.) From Equations between a and c, C. E. only.	....	....	....	+0.673	−0.284	−14.410	....	....	....	+1.460	+0.050	−12.876
(3.) From Equations between a and c, C. W. only.	....	....	....	+0.456	−0.189	−14.345	....	....	....	+1.086	+0.164	−13.370
From Solution for δa, δc, and $\delta\Delta T$.												
(4.) Least Square Solution without Weights, C. E. and C. W.	+0.395	+0.217	−14.916	+0.500	−0.176	−14.302	+0.907	+0.263	−13.379	+1.195	+0.248	−13.090
(5.) Least Square Solution without Weights, C. E. and C. W., $\delta c = 0$.	+0.376	+0.200	−14.930	+0.510	−0.176	−14.356	+0.900	+0.260	−13.382	+1.195	+0.240	−13.082
(6.) Least Square Solution with Weights, C. E. and C. W.	+0.355	+0.215	−14.949	+0.548	−0.214	−14.351	+0.889	+0.272	−13.375	+1.175	+0.266	−13.069
(7.) Least Square Solution with Weights, C. E. only.	+0.179	+0.086	−14.746	+0.544	−0.200	−14.314	+0.811	+0.206	−13.625	+0.996	+0.107	−12.811
(8.) Least Square Solution with Weights, C. W. only.	+0.393	+0.200	−14.970	+0.683	−0.076	−14.545	+1.070	+0.096	−13.681	+1.263	+0.185	−13.236
(9.) Least Square Solution with Weights, C. E. and C. W., $\delta c = 0$.	+0.353	+0.200	−14.954	+0.518	−0.176	−14.340	+0.897	+0.260	−13.397	+1.181	+0.240	−13.064
(10.) Least Square Solution with Weights, C. E. only, $\delta c = 0$.	+0.313	+0.200	−14.930	+0.530	−0.189	−14.432	+0.880	+0.260	−13.349	+1.058	+0.160	−12.892
(11.) Least Square Solution with Weights, C. W. only, $\delta c = 0$.	+0.393	+0.200	−14.968	+0.652	−0.280	−14.369	+0.895	+0.260	−13.406	+1.421	+0.050	−13.439
Adopted values of ΔT at:	h. 13.1			h. 14.9			h. 14.6			h. 14.4		
Mean of (6) and (9).	s. −14.951			s. −14.346			s. −13.386			s. −13.066		
Hourly rate of Clock.	+ 0.023			+ 0.022			+ 0.017			+ 0.013		

Collection of Results for a, c, and ΔT. Montreal Observations.

	June 17, 1883.			June 19, 1883.			June 20, 1883.			June 21, 1883.			June 23, 1883.		
	a.	c.	ΔT.	a.	c.	ΔT.	a.	c.	ΔT.	a.	c.	ΔT.	a.	c.	ΔT.
From Solution for a, c, and ΔT.															
	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.
(1.) From Equations between a and c, L. E. and L. W.	−0.684	+0.306	+6.560	....	....	....	....	....	....	−0.448	−0.035	+6.570	−0.340	−0.060	+6.886
(2.) From Equations between a and c, L. E. only.	....	....	....	−0.650	+0.150	+6.500	....	....	....	−0.581	−0.137	+6.638	....	....	....
(3.) From Equations between a and c, L. W. only.	....	....	....	....	....	....	−0.543	+0.052	+6.405	−0.496	+0.000	+6.670	....	....	....
From Solution for δa, δc, and $\delta\Delta T$.															
(4.) Least Square Solution without Weights, L. E. and L. W.	−0.684	+0.294	+6.578	−0.669	+0.139	+6.518	−0.542	+0.053	+6.419	−0.438	−0.042	+6.541	−0.370	−0.078	+6.812
(5.) Least Square Solution without Weights, L. E. and L. W., $\delta c=0$.	−0.683	+0.310	+6.580	−0.654	+0.150	+6.505	−0.546	+0.050	+6.423	−0.439	−0.040	+6.542	−0.355	−0.060	+6.822
(6.) Least Square Solution with Weights, L. E. and L. W.	−0.680	+0.276	+6.571	....	....	....	....	....	....	−0.488	−0.073	+6.554	−0.393	−0.066	+6.908
(7.) Least Square Solution with Weights, L. E. only.	−0.723	+0.277	+6.574	−0.588	+0.194	+6.437	....	....	....	−0.574	−0.131	+6.632	−0.569	−0.216	+7.159
(8.) Least Square Solution with Weights, L. W. only.	−0.693	+0.315	+6.643	....	....	....	−0.496	+0.077	+6.367	−0.810	+0.180	+7.006	−0.821	+0.419	+7.727
(9.) Least Square Solution with Weights, L. E. and L. W., $\delta c=0$.	−0.671	+0.310	+6.557	....	....	....	....	....	....	−0.503	−0.040	+6.561	−0.390	−0.060	+6.906
(10.) Least Square Solution with Weights, L. E. only, $\delta c=0$.	−0.681	+0.310	+6.519	−0.646	+0.150	+6.505	....	....	....	−0.580	−0.137	+6.638	−0.390	−0.060	+6.901
(11.) Least Square Solution with Weights, L. W. only, $\delta c=0$.	−0.687	+0.310	+6.631	....	....	....	−0.538	+0.050	+6.416	−0.552	+0.000	+6.651	−0.355	−0.060	+6.859
Adopted values of ΔT at:	h. 15.8			h. 14.9			h. 15.2			h. 16.6			h. 19.2		
Mean of (6) and (9)	s. +6.564			s. +6.468			s. +6.391			s. +6.557			s. +6.907		
Hourly rate of Clock	−0.002			−0.002			+0.002			+0.007			+0.007		

It will be seen that the final values of ΔT have been derived from a combination of results (6) and (9). Unless the value of c can be found by the mechanical method, these forms of solution are probably as likely to give the true values of ΔT as any that can be chosen. This selection, however, must always be to a certain extent a question of individual judgment. It will not escape attention that the gain in the introduction of weights is very slight. It can only be said that their use seems to produce a little better accordance of the residuals.

Personal Equation between W. A. Rogers and C. H. McLeod.

The following values of the personal equation between Professor McLeod and myself were derived from observations on two nights at Cambridge and on two nights at Montreal. The plan of observation adopted was for one observer to get three symmetrical tallies, and for the other observer to get the remaining tallies, reversing the order of the tallies for alternate stars.

The results derived from each star observed are given in the following table: —

Cambridge Transit.				Montreal Transit.			
June 28.		June 30.		June 13.		June 14.	
δ.	$(R-M)\cos\delta$.	δ.	$(R-M)\cos\delta$.	δ.	$(R-M)\cos\delta$.	δ.	$(R-M)\cos\delta$.
°	s.	°	s.	°	s.	°	s.
+ 16.9	+0.25	+ 2.4	+0.08	+ 2.4	−0.01	−10.5	+0.09
+ 2.4	+0.19	− 15.5	+0.10	−15.5	+0.06	+73.0	+0.11
− 15.5	+0.01	+ 57.8	+0.17	+59.8	+0.02	− 8.1	+0.13
+ 59.8	+0.08	+ 74.6	+0.05	+74.6	+0.01	+49.9	+0.14
+ 74.6	+0.02	+102.7	+0.17	+40.9	−0.06	+19.0	+0.08
+102.7	+0.10	+ 67.8	+0.13	− 9.0	+0.00	+ 2.4	+0.03
+ 67.8	+0.13	+ 72.3	+0.11	+41.2	+0.04	−15.5	+0.24
+ 72.3	+0.15	+ 27.1	+0.08	+72.3	−0.02	+71.0	+0.00
+ 41.2	+0.15	+ 6.8	+0.05	−22.3	+0.17	+15.8	+0.25
+ 27.1	+0.03	+ 15.8	+0.04	−19.5	+0.09	+18.5	+0.09
+ 6.8	+0.20	+ 18.5	+0.18	+18.5	+0.13	+78.9	+0.19
+ 15.8	+0.15	+ 78.1	+0.08	+78.1	+0.07	−22.3	+0.06
+ 45.2	+0.14	− 22.3	+0.19	+58.9	+0.10	−19.5	+0.31
− 3.4	+0.15	− 19.5	+0.18	−26.2	+0.09	+58.9	+0.13
+ 76.2	+0.08	+ 45.3	+0.10	+21.7	+0.20	− 3.4	+0.10
− 26.2	+0.08	− 3.4	+0.25	+39.9	+0.23	− 4.4	+0.09
+ 21.7	+0.22	+ 19.4	+0.23	+82.2	+0.18	+76.2	+0.27
+ 69.0	+0.08	+ 76.0	+0.12	+79.1	+0.06	+19.4	+0.07
− 10.3	+0.13	+ 21.8	+0.05	+57.0	+0.11	+76.0	+0.04
+ 39.8	+0.21	− 10.3	+0.32	+ 9.5	+0.21	+21.8	+0.05
+ 57.0	+0.11	+104.6	+0.10	+14.5	+0.18	+69.0	+0.08
+ 9.6	+0.34	+ 39.1	+0.21	+74.1	+0.04	+39.1	+0.14
+ 14.5	+0 20	+ 57.0	+0.09	+12.6	+0.30	+57.0	+0.07
− 24.9	+0.16	+ 9.5	+0.27			+ 9.5	−0.05
+ 52.4	+0.23	+100.9	+0.05			+82.2	+0.14
+ 12.6	+0.12	+ 14.5	+0.14			+79.6	+0.02
		− 22.9	+0.21			+13.5	+0.30
		+ 12.6	+0.28			+75.0	+0.04
Mean	*+0.143*	....	*+0.144*	Mean	*+0.096*	....	*+0.115*

By combination we have —

From mean of observations at Cambridge, $(R - M) \cos \delta = +0^s.144.$
From mean of observations at Montreal, $(R - M) \cos \delta = +0^s.103.$

Arranging the results in the order of declination, we have —

From Observations at Cambridge.								From Observations at Montreal.							
$(R-M) \cos \delta$.								$(R-M) \cos \delta$.							
δ.		δ.		δ.		δ.		δ.		δ.		δ.		δ.	
°	s.	°	s.	°	s.	°	s.	°	s.	°	s.	°	s.	°	s.
−15.5	+0.01	+16.9	+0.25	+59.8	+0.08	+74.6	+0.02	−15.5	+0.06	+ 2.4	−0.01	+59.8	+0.02	+74.6	+0.15
− 3.4	+0.15	+ 2.4	+0.19	+41.3	+0.15	+67.8	+0.13	− 8.9	+0.00	+18.5	+0.13	+40.9	−0.06	+72.2	−0.02
−26.2	+0.08	+27.1	+0.03	+45.3	+0.14	+72.3	+0.15	−22.3	+0.17	+21.8	+0.20	+41.2	+0.04	+78.2	+0.07
−10.3	+0.13	+ 6.8	+0.20	+39.1	+0.21	+76.2	+0.08	−19.5	+0.09	+ 9.5	+0.21	+58.9	+0.10	+82.2	+0.18
−24.9	+0.16	+15.8	+0.15	+57.0	+0.11	+69.0	+0.08	−26.2	+0.09	+14.5	+0.18	+39.2	+0.23	+79.1	+0.06
−15.5	+0.10	+21.8	+0.22	+52.4	+0.23	+74.6	+0.05	−10.5	+0.09	+12.6	+0.30	+57.0	+0.11	+74.1	+0.04
−22.3	+0.19	+ 9.6	+0.34	+57.8	+0.17	+67.8	+0.13	− 8.6	+0.13	+19.0	+0.08	+49.9	+0.14	+73.0	+0.11
−19.5	+0.18	+14.5	+0.20	+45.2	+0.10	+72.3	+0.11	−15.5	+0.24	+ 2.4	+0.03	+58.9	+0.13	+71.0	+0.00
− 3.4	+0.25	+12.7	+0.12	+39.2	+0.21	+78.1	+0.08	−22.3	+0.06	+15 8	+0.25	+39.2	+0.14	+78.1	+0.19
−10.3	+0.32	+ 2.4	+0.08			+76.0	+0.12	−19.5	+0.31	+18.5	+0.09	+57.0	+0.07	+76.2	+0.27
−22.9	+0.21	+27.1	+0.08			+57.0	+0.09	− 3.4	+0.10	+19.4	+0.07			+76.0	+0.04
		+ 6.8	+0.05					− 4.4	+0.09	+21.7	+0.05			+68.0	+0.08
		+15.8	+0.04							+ 9.5	+0.05			+82.2	+0.14
		+18.5	+0.18							+13.5	+0.30			+79.1	+0.14
		+19.0	+0.23											+75.0	+0.04
		+21.8	+0.05												
		+ 9.5	+0.27												
		+14.5	+0.14												
		+12.6	+0.28												
−15.8	*+0.162*	*+14.5*	*+0.163*	*+48.6*	*+0.156*	*+71.4*	*+0.095*	*−13.8*	*+0.119*	*+14.2*	*+0.138*	*+50.2*	*+0.092*	*+75.9*	*+0.099*

It appears from these results that there is a slight diminution of the value of the equation corresponding to an increase of the declination of the star observed.

The clock comparisons for the difference in longitude will appear in the report of Professor McLeod, also the observed data for the determination of the longitude by star transits. By arrangement with Professor McLeod, he will undertake all the work involving the definitive determination of the longitude from the data obtained at the two stations.

WM. A. ROGERS.

Harvard College Observatory,
Nov. 2, 1885.

PART III.

In Table VI, the second and sixth columns give the corresponding means of readings at every fifth second for each minute of the comparison of the two clocks. These comparison readings were made with a scale graduated to tenths of a second, and the readings were estimated to hundredths of a second. The third column is obtained directly from the second by means of the data in the Nautical Almanac. The clock corrections are from Table III, by applying the rates there given. The fifth and eighth columns give the sums of the two previous columns and the last column is the difference for each minute of the Cambridge and Montreal sidereal times.

Table VI.—Exchange of Clock Signals.

Date.	Montreal mean-time clock.	Equivalent sidereal time.	Clock correction.	Montreal sidereal time.	Cambridge sidereal clock.	Clock correction.	Cambridge sidereal time.	Difference of C.S.T. & M.S.T.
				MONTREAL CHRONOGRAPH.				
1883.	h. m. s.	h. m. s.	s.	s.	h. m. s.	s.	s.	m. s.
June 2	10 46 28.500	15 31 30.249	+ 2.012	32.261	15 41 33.797	— 14.329	19.468	9 47.207
2	10 47 28.500	15 32 30.414	+ 2.013	32.427	15 42 33.958	— 14.328	19.630	9 47.203
2	10 48 28.500	15 33 30.578	+ 2.013	32.591	15 43 34.124	— 14.328	19.796	9 47.205
2	10 49 28.500	15 34 30.742	+ 2.013	32.755	15 44 34.317	— 14.328	19.989	9 47.234
2	10 50 28.500	15 35 30.906	+ 2.014	32.920	15 45 34.485	— 14.327	20.158	9 47.238
2	10 51 28.500	15 36 31.071	+ 2.014	33.085	15 46 34.649	— 14.327	20.322	9 47.237
Mean.								9 47.221
June 4	10 19 28.500	15 12 18.924	+ 3.241	22.165	15 22 22.833	— 13.373	9.460	9 47.295
4	10 20 28.500	15 13 19.088	+ 3.241	22.329	15 23 23.010	— 13.373	9.637	9 47.308
4	10 21 28.500	15 14 19.253	+ 3.242	22.495	15 24 23.183	— 13.372	9.811	9 47.316
4	10 22 28.500	15 15 19.417	+ 3.242	22.659	15 25 23.348	— 13.372	9.976	9 47.317
4	10 23 28.500	15 16 19.581	+ 3.242	22.823	15 26 23.515	— 13.372	10.143	9 47.320
4	10 24 28.500	15 17 19.745	+ 3.243	22.988	15 27 23.673	— 13.371	10.302	9 47.314
4	10 25 28.500	15 18 19.910	+ 3.243	23.153	15 28 23.837	— 13.371	10.466	9 47.313
4	10 26 28.500	15 19 20.074	+ 3.243	23.317	15 29 24.001	— 13.371	10.630	9 47.313
4	10 27 28.500	15 20 20.238	+ 3.244	23.482	15 30 24.161	— 13.371	10.790	9 47.308
4	10 28 28.500	15 21 20.402	+ 3.244	23.646	15 31 24.327	— 13.370	10.957	9 47.311
4	10 29 28.500	15 22 20.567	+ 3.244	23.811	15 32 24.500	— 13.370	11.130	9 47.319
Mean.								9 47.312
June 5	10 15 31.500	15 12 17.835	+ 3.796	21.631	15 22 21.859	— 13.053	8.806	9 47.175
5	10 16 31.500	15 13 17.999	+ 3.796	21.795	15 23 22.013	— 13.053	8.960	9 47.165
5	10 17 31.500	15 14 18.163	+ 3.797	21.960	15 24 22.191	— 13.053	9.138	9 47.178
5	10 18 31.500	15 15 18.328	+ 3.797	22.125	15 25 22.346	— 13.053	9.293	9 47.168
5	10 19 31.500	15 16 18.492	+ 3.797	22.289	15 26 22.517	— 13.053	9.464	9 47.175
5	10 20 31.500	15 17 18.656	+ 3.797	22.453	15 27 22.687	— 13.052	9.635	9 47.182
5	10 21 31.500	15 18 18.821	+ 3.798	22.619	15 28 22.848	— 13.052	9.796	9 47.177
5	10 22 31.500	15 19 18.985	+ 3.798	22.783	15 29 23.017	— 13.052	9.965	9 47.182
5	10 23 31.500	15 20 19.149	+ 3.798	22.947	15 30 23.199	— 13.052	10.147	9 47.200
5	10 24 31.500	15 21 19.313	+ 3.798	23.111	15 31 23.358	— 13.051	10.307	9 47.196
5	10 25 31.500	15 22 19.478	+ 3.799	23.277	15 32 23.528	— 13.051	10.477	9 47.200
Mean.								9 47.182
				CAMBRIDGE CHRONOGRAPH.				
June 2	10 34 27.500	15 19 27.275	+ 2.007	29.282	15 29 30.936	— 14.333	16.603	9 47.321
2	10 35 27.500	15 20 27.439	+ 2.007	29.446	15 30 31.105	— 14.333	16.772	9 47.326
2	10 36 27.500	15 21 27.604	+ 2.008	29.612	15 31 31.263	— 14.332	16.931	9 47.319
Mean.								9 47.322
June 4	10 08 27.500	15 01 16.114	+ 3.238	19.352	15 11 20.166	— 13.376	6.790	9 47.438
4	10 09 27.500	15 02 16.278	+ 3.238	19.516	15 12 20.327	— 13.376	6.951	9 47.435
4	10 12 27.500	15 05 16.771	+ 3.239	20.010	15 15 20.812	— 13.375	7.437	9 47.427
4	10 13 27.500	15 06 16.935	+ 3.239	20.174	15 16 20.978	— 13.375	7.603	9 47.429
4	10 14 27.500	15 07 17.100	+ 3.239	20.339	15 17 21.140	— 13.374	7.766	9 47.427
4	10 15 27.500	15 08 17.264	+ 3.240	20.504	15 18 21.314	— 13.374	7.940	9 47.436
Mean.								9 47.432
June 5	10 04 27.500	15 01 12.017	+ 3.793	15.810	15 11 16.147	— 13.056	3.093	9 47.283
5	10 05 27.500	15 02 12.181	+ 3.793	15.974	15 12 16.306	— 13.056	3.250	9 47.276
5	10 08 27.500	15 05 12.674	+ 3.794	16.468	15 15 16.807	— 13.055	3.752	9 47.284
5	10 09 27.500	15 06 12.838	+ 3.795	16.633	15 16 16.964	— 13.055	3.909	9 47.276
5	10 10 27.500	15 07 13.002	+ 3.795	16.797	15 17 17.137	— 13.055	4.082	9 47.285
5	10 11 27.500	15 08 13.167	+ 3.795	16.962	15 18 17.297	— 13.054	4.243	9 47.281
Mean.								9 47.281

Table VI. *Continued.*—Exchange of Clock Signals.

Date.	Montreal mean-time clock.	Equivalent sidereal time.	Clock correction.	Montreal sidereal time.	Cambridge sidereal clock.	Clock correction.	Cambridge sidereal time.	Difference of C. S. T. & M. S. T.
				MONTREAL CHRONOGRAPH.				
1883.	h. m. s.	h. m. s.	s.	s.	h. m. s.	s.	s.	m. s.
June 20	10 24 27.500	16 20 23.662	+ 6.393	30.055	16 30 27.777	− 9.959	17.818	9 47.763
20	10 26 27.500	16 22 23.991	+ 6.393	30.384	16 32 28.103	− 9.959	18.144	9 47.760
20	10 27 27.500	16 23 24.155	+ 6.393	30.548	16 33 28.267	− 9.959	18.308	9 47.760
20	10 30 27.500	16 26 24.648	+ 6.393	31.041	16 36 28.763	− 9.959	18.804	9 47.763
20	10 31 27.500	16 27 24.812	+ 6.394	31.206	16 37 28.925	− 9.959	18.966	9 47.760
20	10 32 27.500	16 28 24.977	+ 6.394	31.371	16 38 29.080	− 9.959	19.121	9 47.750
20	10 33 27.500	16 29 25.141	+ 6.394	31.535	16 39 29.247	− 9.959	19.288	9 47.753
Mean.								9 47.758
June 21	10 27 27.500	16 27 20.705	+ 6.556	27.261	16 37 24.784	− 9.892	14.892	9 47.631
21	10 28 27.500	16 28 20.869	+ 6.556	27.425	16 38 24.945	− 9.892	15.053	9 47.628
21	10 29 27.500	16 29 21.034	+ 6.556	27.590	16 39 25.117	− 9.892	15.225	9 47.635
21	10 30 27.500	16 30 21.198	+ 6.556	27.754	16 40 25.286	− 9.892	15.394	9 47.640
21	10 33 27.500	16 33 21.691	+ 6.557	28.248	16 43 25.791	− 9.891	15.900	9 47.652
21	10 34 27.500	16 34 21.855	+ 6.557	28.412	16 44 25.948	− 9.891	16.057	9 47.645
21	10 40 27.500	16 40 22.841	+ 6.558	29.399	16 50 26.933	− 9.891	17.042	9 47.643
21	10 41 27.500	16 41 23.005	+ 6.558	29.563	16 51 27.098	− 9.891	17.207	9 47.644
21	10 42 26.500	16 42 23.169	+ 6.558	29.727	16 52 27.253	− 9.891	17.362	9 47.635
Mean.								9 47.639
June 23	10 57 27.500	17 05 18.743	+ 6.892	25.635	17 15 22.890	− 9.550	13.340	9 47.705
23	10 58 27.500	17 06 18.908	+ 6.892	25.800	17 16 23.060	− 9.550	13.510	9 47.710
23	10 59 27.500	17 07 19.072	+ 6.892	25.964	17 17 23.219	− 9.550	13.669	9 47.705
23	11 02 27.500	17 10 19.565	+ 6.893	26.458	17 20 23.717	− 9.549	14.168	9 47.710
23	11 03 27.500	17 11 19.729	+ 6.893	26.622	17 21 23.878	− 9.549	14.329	9 47.707
23	11 04 27.500	17 12 19.893	+ 6.893	26.786	17 22 24.043	− 9.549	14.494	9 47.708
23	11 05 27.500	17 13 20.058	+ 6.893	26.951	17 23 24.201	− 9.549	14.652	9 47.701
23	11 06 27.500	17 14 20.222	+ 6.893	27.115	17 24 24.357	− 9.549	14.808	9 47.693
23	11 51 27.500	17 59 27.614	+ 6.898	34.512	18 09 31.765	− 9.545	22.220	9 47.708
23	11 52 27.500	18 00 27.779	+ 6.898	34.677	18 10 31.932	− 9.545	22.387	9 47.710
23	11 53 27.500	18 01 27.943	+ 6.898	34.841	18 11 32.095	− 9.545	22.550	9 47.709
Mean.								9 47.706
				CAMBRIDGE CHRONOGRAPH.				
June 20	10 12 30.000	16 08 24.198	+ 6.393	30.591	16 18 28.381	− 9.960	18.421	9 47.830
20	10 13 30.000	16 09 24.362	+ 6.393	30.755	16 19 28.553	− 9.960	18.593	9 47.838
20	10 14 30.000	16 10 24.527	+ 6.393	30.920	16 20 28.735	− 9.960	18.775	9 47.855
20	10 17 30.000	16 13 25.019	+ 6.393	31.412	16 23 29.208	− 9.960	19.248	9 47.836
20	10 18 30.000	16 14 25.184	+ 6.393	31.577	16 24 29.363	− 9.960	19.403	9 47.826
Mean.								9 47.837
June 21	10 14 30.000	16 14 21.077	+ 6.554	27.631	16 24 25.250	− 9.893	15.357	9 47.726
21	10 15 30.000	16 15 21.241	+ 6.555	27.796	16 25 25.415	− 9.893	15.522	9 47.726
21	10 16 30.000	16 16 21.405	+ 6.555	27.960	16 26 25.582	− 9.893	15.689	9 47.729
21	10 17 30.000	16 17 21.569	+ 6.555	28.124	16 27 25.745	− 9.893	15.852	9 47.728
21	10 20 30.000	16 20 22.062	+ 6.555	28.617	16 30 26.245	− 9.892	16.353	9 47.736
21	10 21 30.000	16 21 22.227	+ 5.555	28.782	16 31 26.407	− 9.892	16.515	9 47.733
Mean.								9 47.730
June 23	10 44 27.500	16 52 16.608	+ 6.891	23.499	17 02 20.827	− 9.551	11.276	0 47.777
23	10 45 27.500	16 53 16.772	+ 6.891	23.663	17 03 20.983	− 9.551	11.432	9 47.769
23	10 46 27.500	16 54 16.936	+ 6.891	23.827	17 04 21.142	− 9.551	11.591	9 47.764
23	10 50 27.500	16 58 17.593	+ 6.891	24.484	17 08 21.822	− 9.550	12.272	9 47.788
23	10 51 27.500	16 59 17.758	+ 6.891	24.649	17 09 21.978	− 9.550	12.428	9 47.779
Mean.								9 47.775

Table VII, below, contains the results of the star transit signals on June 23rd. Under T is given the clock-face times of transit of the mean wires, as recorded on the chronographs. The next three columns contain respectively the corrections for level, azimuth and collimation. Under $R–M$ are the reductions of my observations to Prof. Rogers as the normal observer. Column H contains a correction for the transmission and armature time (see Table VIII); column M, the corrected times of meridian passages; and the last column the differences between these quantities, which is a measure of the difference in longitude of the stations.

Table VII.

Name of Star.	δ	Where observed.	T	Bb	$A(a+da)$	$C(c+dc)$	R-M	H	M	Diff.
RECORD ON MONTREAL CHRONOGRAPH.										
	° ′		h. m. s.	s.	s.	s.	s.	s.	m. s.	m. s.
ξ Draco. - -	+ 56 53	Camb.	17 41 38.64	— .04	— .05	+ .47	+ .24	— .04	41 39.22	9 47.30
" - -	"	Mont.	17 51 26.28	+ .21	+ .14	— .11	......	......	51 26.52	
109 Hercu. - -	+ 21 43	Camb.	18 08 51.24	— .04	+ .04	+ .28	+ .16	— .04	8 51.64	9 47.50
" - -	"	Mont.	18 18 39.26	+ .12	— .17	— .07	......	......	18 39·14	
α Lyræ - -	+ 38 41	Camb.	18 23 07.02	— .08	+ .01	+ .33	+ .19	— .04	23 07.43	9 47.25
" - -	"	Mont.	18 32 54.67	+ .15	— .06	— .08	......	......	32 54.68	
β Lyræ - -	+ 33 14	Camb.	18 35 54.02	— .11	+ .02	+ .30	+ .18	— .04	35 54.37	9 47.45
" - -	"	Mont.	18 45 41.86	+ .14	— .10	— .08	......	......	45 41.82	
α Aquil. - -	+ 8 .34	Camb.	19 35 13.03	— .15	+ .06	+ .26	+ .16	— .04	35 13.32	9 47.53
" - -	"	Mont.	19 45 01.04	+ .11	— .24	— .06	......	......	45 00.85	
Mean -										9 47.406
RECORD ON CAMBRIDGE CHRONOGRAPH.										
α Cygni. - -	+ 44 51	Camb.	20 37 39.26	— .30	— .01	+ .36	+ .20	......	37 39.51	9 47.54
"	"	Mont.	20 47 26.96	+ .23	— .01	— .09	......	— .04	47 27.05	
61 Cyg. pr. -	+ 38 10	Camb.	21 01 51.87	— .28	+ .01	+ .32	+ .18	......	1 52.10	9 47.66
"	"	Mont.	21 11 39.70	+ .24	— .06	— .08	......	— .04	11 39.76	
ζ Cygni. - -	+ 29 45	Camb.	21 08 09.89	— .26	+ .03	+ .29	+ .17	......	8 10.12	9 47.37
"	"	Mont.	21 17 57.50	+ .22	— .12	— .07	......	— .04	17 57.49	
Mean -										9 47.523

The mean of both series and resulting $\Delta\lambda$ is $9^{m}\ 47^{s}.465 \pm .034$.

In Table VIII, the column D_1 and D_2 contains the mean results of the clock comparisons from Table VI, while $\frac{1}{2}(D_1 + D_2)$ gives the difference of longitude, uncorrected for personal equation, resulting from each night's work. The corrections for personal equation have been obtained from the values for $R–M = .130 \sec^{\frac{3}{4}}\delta$, and $= .154 \sec^{\frac{3}{4}}\delta$, and represent the average of $R–M$ for all the stars observed by me on each of the nights. By applying these quantities to those in the previous column, my clock corrections are reduced to those of Prof. Rogers, whose absolute equation is known to be near zero. The column $\Delta\lambda$ therefore contains the difference of longitude obtained on each night. The combining

weights have been obtained by combining the probable errors of all the quantities upon which the several values of $\Delta\lambda$ depend. The probable error of the clock correction at Montreal, on June 20th, was large, on account of the small number of stars observed and these being all in one position of the instrument. The cause of the difference between the armature and transmission times in the first and second series has already been referred to. No account has been taken of this in obtaining the final value of $\Delta\lambda$.

Table VIII.

Date.	Direction of signals.	D_1 and D_2	$\frac{1}{2}(D_1 + D_2)$	Personal Equation.	$\Delta\lambda$	Armature and transmission time.	Combining weight.
FIRST SERIES.							
1883.		m. s.	m. s.	s.	m. s.	s.	
June 2	C. to M.	9 47.221	9 47.271	+ 0.229	9 47.500	.050	6
"	M. to C.	9 47.322					
June 4	C. to M.	9 47.312	9 47.372	+ 0.251	9 47.623	.060	8
"	M. to C.	9 47.432					
June 5	C. to M.	9 47.182	9 47.232	+ 0.214	9 47.446	.050	4
"	M. to C.	9 47.281					
Arithmetical Means for first series.			9 47.292	....	9 47.523	.053	
Mean for first series from combination by weights.			....	....	9 47.542		
SECOND SERIES.							
June 20	C. to M.	9 47.758	9 47.797	— 0.198	9 47.599	.040	1
"	M. to C.	9 47.837					
June 21	C. to M.	9 47.639	9 47.685	— 0.263	9 47.422	.045	4
"	M. to C.	9 47.730					
June 23	C. to M.	9 47.706	9 47.741	— 0.235	9 47.506	.035	7
"	M. to C.	9 47.775					
Arithmetical means for second series.			9 47.741	....	9 47.509	.040	
Arithmetical means for both series.			9 47.516	....	9 47.516	.047	
Mean for second series from combination by weights.			....	....	9 47.486		
Mean of both series as combined by weights.					9 47.514	± .020	
From exchange of star transits on June 23rd.					9 47.465	± .034	3
Final value of $\Delta\lambda$, by weights, from all sources.					9 47.510	± .019	

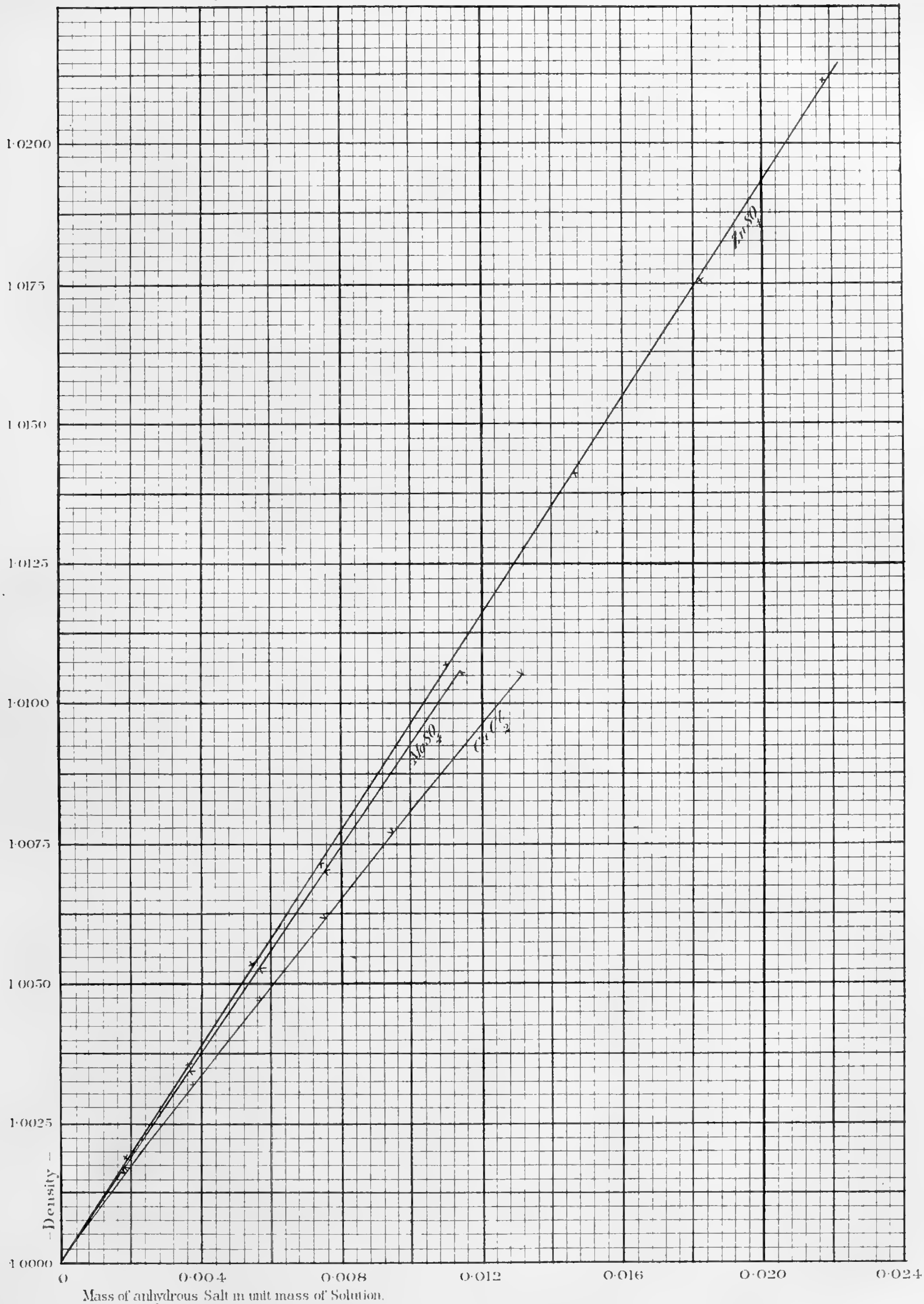
The probable errors of the values of $\Delta\lambda$ from "both series" and from "all sources" given above are those which result from the residuals for each night. The probable error of the "final value of $\Delta\lambda$" which results from combining the probable errors of the separate values of $\Delta\lambda$ on each night is $\pm$ .007.

The Russian transit is 41 feet to the west of the centre of the dome of the Harvard College Observatory of which the longitude is :—

	—	$4^h\ 44^m\ 30^s.993 \pm .041$
Reduction of dome to Russian transit	—	0.040
$\Delta\lambda$ of Montreal and Cambridge Stations,	—	0 9 47.510 $\pm$ .019

The pier of the transit instrument at the McGill College Observatory is therefore in longitude

$4^h\ 54^m\ 18^s.543 \pm .045$ West of Greenwich.



To illustrate Prof. MacGregor's Paper on the Density of Weak Aqueous Solutions of certain Salts.

THE BURLAND LITH CO MONTREAL

ROYAL SOCIETY OF CANADA.

TRANSACTIONS

SECTION IV.

GEOLOGICAL AND BIOLOGICAL SCIENCES.

PAPERS FOR 1885.

I.—*On the Mesozoic Floras of the Rocky Mountain Region of Canada.*

By SIR J. WILLIAM DAWSON, C.M.G., LL.D., F.R.S.

(Presented May 27, 1885.)

In a paper read before this Society in 1883, and published in the first volume of its Transactions, I noticed the Cretaceous and Tertiary floras of British Columbia and the Northwest Territories, known up to that time, and described the new species which they had afforded. The lowest Cretaceous flora, that of the Queen Charlotte Islands, has a strictly Mesozoic aspect and affords no Dicotyledonous plants. That of the Dunvegan group on Peace River, on the contrary, abounds in Dicotyledons, and may be regarded as a Middle Cretaceous flora of the age of the Niobrara group or Cenomanian, and is warm-temperate or sub-tropical. The assemblage of plants associated with the coal beds of Vancouver is distinctly Upper Cretaceous, and in its generic forms has a very modern aspect and a decidedly warm-temperate character. A still newer flora is that of the Laramie series, which may be regarded as a transition group connecting the Upper Cretaceous with the Eocene, and is still warm-temperate in its aspect, though differing in its specific, and to some extent in its generic forms.

The material at that time in my hands showed nothing from the Rocky Mountain region certainly Lower Cretaceous, and nothing between the Queen Charlotte series and that of Peace River to fill up the great gap separating these very distinct groups of plants, except a small collection from Suskwa River and Willow Creek, containing the species which I named *Dioonites borealis*, *Pinus Suskwaensis* and *Laurus crassinervis.* These I believed to indicate an horizon lower than that of the Dunvegan group of Peace River, but this could not at the time be regarded as certain.

In the past summer considerable collections have been made by Dr. G. M. Dawson, from troughs of Mesozoic rocks included in the older formations of the Rockies, and which show the existence there of a series of fossil plants whose affinities with those of other regions would entitle them to be called Jurasso-Cretaceous. They consist of ferns, cycads and conifers, some of them identical with, or closely allied to, those of the Jurassic of the Amur country in Siberia, and others similarly related to those of the Lower Cretaceous of Greenland, as these floras have been described by Heer. This group, undoubtedly, represents the flora of the Lowest Cretaceous, which has not hitherto been recognized in Western America, and will form a sure basis from which to trace the development of the vegetable kingdom upward to its more modern forms. Unfortunately, a considerable thickness of beds overlying those holding these more ancient plants, has afforded no fossils, and the next beds in ascending order which afford plants contain, in addition to survivors of the older flora, a few new forms belonging to the Dicotyledo-

nous class. Still higher in the series, the strata abound in Dicotyledonous leaves, closely allied to those of the Dakota series of the United States geologists.

It is proposed to name the older series the KOOTANIE SERIES, after a tribe of Indians who hunted in the country in which it occurs. The upper series may be named, after a typical locality, the MILL CREEK SERIES, and the plants occurring between these two horizons may be termed for the present those of the INTERMEDIATE SERIES. There is good reason to believe that the Mill Creek series is somewhat older than that named in my former paper the Dunvegan group of Peace River.

Dr. G. M. Dawson has furnished the following notes as to what is known of the stratigraphy and distribution of these several groups of strata:—

"Where the Rocky Mountains are intersected by the forty-ninth parallel they form a compact range, entirely composed of Palæozoic rocks, from their base at the eastern foot-hills to the great Kootanie-Columbia valley on the west.[1] About thirty miles further north, however, important masses of Lower Cretaceous or Jurasso-Cretaceous rocks become involved in the flexures of the older series, upon which they rest with more or less angular unconformity. These rocks also hold, at several stages, conglomerates composed of the underlying series which probably stood out in insular masses in many places. The Cretaceous rocks generally appear to occupy synclinals, which are either simple and narrow, or several miles in width, and hold a number of parallel, more or less closely compressed, folds, which in several cases have been observed to be overturned to the east or north-east. Similar sharp parallel folding occurs in the foot-hill country, which forms a belt along the eastern base of the range; and though, owing to the amount of disturbances, it has hitherto been found impossible to work out the structure in detail, it is probable that sections will ultimately be obtained embracing the entire thickness of the Cretaceous formation, together with a portion of the Laramie. In the region of the great plains, north of the forty-ninth parallel, none of the Cretaceous rocks yet known can be assigned to a position lower than that of the Benton group, and to the south and south-east, in the western states and territories, the basal beds of the Cretaceous, wherever exposed, are of the age of the Dakota group. In connection with the folding above described, however, while some beds probably referable to the Dakota period have been recognized by their fossils, there is evidence of the existence of a much earlier stage of the Cretaceous, which it is proposed to designate locally as the Kootanie series. These rocks consist largely of sandstones, interbedded with shales and shaly sandstones, and including occasional beds of conglomerate; and a zone containing coal seams, which are sometimes of considerable thickness, is represented at a number of different localities. While it is evident on stratigraphical grounds that the position of these beds is far down in the thick series of Cretaceous rocks here represented, no fossils have yet been obtained from them save the plants described in this paper, and on these alone their reference to any particular horizon in the Cretaceous must rest.

"The localities from which plants of this stage have already been collected are scattered over a considerable area north of the forty-ninth parallel and south of Bow River, the length of which may be stated as about 140 miles, with an extreme breadth of

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[1] There are, it is true, in several places, comparatively small areas of red rocks, believed to be Triassic, but these are conformable with the Devonio-Carboniferous limestone series beneath.

forty miles. Coal Creek and Martin Creek, from which some of the best preserved specimens are derived, are small tributaries of Elk River, on Crow's Nest Pass, west of the watershed range. The point on the north-west branch of the North Fork of Old Man River, which has yielded a small collection, is at an angle of that branch, about two miles above its mouth, east of the watershed range, and between it and the Livingstone range. A few specimens were also obtained on the North Fork, about two miles east of the Livingstone range, in the foot-hill belt. Others were found in the valley of the first small stream crossed by the trail at the entrance to the North Kootanie Pass, and a small collection was also made on Bow River, opposite Canmore Station on the Canadian Pacific Railway. In all these localities the plants were closely associated with seams of coal, which in the last mentioned has become an anthracite. It is further probable, on the evidence of a few fragmentary plants of the same character, that the coals found in the Middle Fork of the Old Man, two miles below the falls, are on or near the same horizon.

" That the series characterized by these plants is a wide-spread and important one, is shown by the fact that one of the species (*Pinus Suskwaensis*) had previously been found on Suskwa River, in northern British Columbia, at a distance of 580 miles north-west of the most northern locality above mentioned. This place is within 150 miles of the Pacific coast, in the centre of a wide area of Cretaceous rocks, chiefly sandstones. In these, at another point, some miles distant, a single mollusc was also found, which appears to be a Thracia, and is regarded by Mr. Whiteaves as very near to, if not specifically identical with, *T. semiplanata*. This species is one of those found in the Cretaceous rocks of the Queen Charlotte Islands about 250 miles distant, which are believed to be of the age of the Gault; and, while it is by no means certain that the horizon from which this fossil was obtained is the same with that yielding *Pinus Suskwaensis*, its presence tends to show that the very thick Cretaceous series of the Skeena and Suskwa region may, in part at least, represent the coal-bearing rocks of the Queen Charlotte Islands.

" Respecting the other places mentioned in this paper, as localities from which plants referable to later stages in the Cretaceous have been collected, the following notes may be given :—

North Branch, North Fork, Old Man River. This place is eight miles from 'The Gap,' where the North Fork leaves the mountains, and within the Livingstone Range.

North-west Branch, North Fork, Old Man River. The fossils so referred are from a point further up the branch than those of the Kootanie series found on the same stream, about fourteen miles from its mouth, and a quarter of a mile up a small stream which enters from the north.

Mill Creek, a tributary of the South Branch of Old Man River in the foot-hills. The specimens are from several points a few hundred yards above the Mill.

South Saskatchewan. Collections from places a few miles below the junction of the Bow and Belly Rivers, near Cairn Hill.

Saskatchewan Coal Mine, near Medicine Hat, on the South Saskatchewan.

Pincher Creek. From cliffs and high banks in the valley, just above the crossing place of the road to the Mill. These beds are in the upper part of the St. Mary subdivision of the Laramie."

It will be observed, that the above stratigraphical notes refer to beds holding fossil plants which range from a very low Cretaceous or Jurasso-Cretaceous horizon upward to

that of the Laramie, which at present is held by Cope and others, on the evidence of its animal fossils, to be Cretaceous, while by Lesquereux its flora is regarded as Eocene. On this question I may remark that as far back as 1875, (when my attention was first called to the flora of this group, by the collections made by Dr. G. M. Dawson in his explorations on the 49th parallel,) I held, on the evidence of the plants, though contrary to what I then believed and still believe to be inaccurate conclusions of certain European palæobotanists, that it should be regarded as a transition group connecting the Cretaceous and the Eocene, and at the same time I stated reasons for believing that the so-called Miocene of Mackenzie River, and of the Fort Union group in the United States, was probably of the same age. I have since that time seen no reason to change my opinion, but on the contrary have found evidence to show that the Laramie flora, or several of its species, may be traced downward into the Cretaceous as far as the beds known as the Pierre group of the geologists of the United States, and those called the Belly River group by the officers of the Geological Survey of Canada. I have been pleased to observe that in Vol. VIII of the Reports of the U. S. Geological Survey of the Territories (1883), Lesquereux now admits that the Laramie is Lower Eocene; and I have no doubt that, as the evidence accumulates, he will come over to the opinion that its flora is really that of the newest Cretaceous; as it has long been held to be in the Canadian territory. It is to be observed, however, that this will carry with it important modifications of opinion as to the Cretaceous and Tertiary floras of the whole northern hemisphere,—points to which I am glad to see that Mr. Starkie Gardner has recently called attention in Great Britain, and to which I shall refer in the sequel of this paper.

I shall now proceed to describe the new plants which have been obtained from the Kootanie and Mill Creek series and the intermediate beds, and to discuss their relations to those elsewhere known in the Mesozoic and Tertiary. With reference to the generic names assigned to these plants, I would desire it to be understood that they are intended to indicate, in the case of leaves more especially, their resemblance to modern genera, but without any dogmatic assertion as to precise affinities. Many dicotyledonous leaves of the Cretaceous might be referred with almost equal probability to several modern genera, and since we know that, in modern times, certain genera present in their different species modifications of foliage more or less imitative of those of other groups, we may well hesitate in affirming that a particular type of leaf was, in Cretaceous times, associated with precisely the same kind of fructification as that which accompanies it in modern times. At the same time it is well known that many kinds of foliage, especially in the case of trees, are markedly characteristic of particular groups; and, since we cannot fairly conclude that the connection of a certain type of leaf with a certain structure of stem and character of fruit is an accident, but must believe that it depends on some law of physiological correlation, we have good reason to rely on this when other evidence is absent. I may state, however, as the result of my experience in many cases, that the conclusions deduced from the leaves have often been confirmed, by the subsequent discovery in association with them of the tissues of their stems, and of the forms of their fruits. It is also to be observed that, plants afford indications of climate and other physical conditions, even more trustworthy than those which can be obtained from animal fossils. From a geological point of view it is to be observed, that while the names assigned to particular leaves may be disputable, the occurrence of the leaves themselves in certain strata over wide areas affords

good palæontological evidence; since these leaves are quite as easily recognized by one familiar with their forms and structures, as any other kinds of fossils.

I shall only premise further that, in referring plants to particular genera and families, I have not been influenced in the least degree by any preconceived ideas as to the probable order of succession of vegetable forms. No one has a right to affirm that, in the case of dicotyledonous plants for example, those families having monœcious or diœcious flowers should have appeared earlier or later than those having bisexual flowers. Long experience in palæontology has convinced me, that the earlier forms of any group of plants or animals may be precisely those which certain framers of hypotheses would least have expected, and that here, as in other departments of the study of nature, we must be prepared to take facts as we find them, in whatever way they may affect our *a priori* opinions.

I.—Kootanie Series.

1. *Filices.*

Dicksonia, Sp.

Pinnate, pinnæ linear, two centimetres long, with rounded sessile pinnules united at their bases. Venation obscure, but apparently of the type of *D. concinna*, Heer, from the Jurassic of Eastern Siberia. The specimens are not quite so distinct as to warrant referring them to Heer's species, yet are so near to it that I hesitate to separate them. They are decidedly of the same type.

Collected by Dr. George M. Dawson at Martin Brook.[1]

Asplenium Martinianum, S. N. (Plate I. Fig. 1.)

Bipinnate, pinnæ long, with somewhat stout petiole. Pinnules contiguous, broad, curved upward, obliquely rounded at their extremities, attached by their whole bases. Midrib delicate, evanescent at distal end, veins very fine, oblique, forking twice. In the specimens studied the pinnae are 9 centimetres long, and at right angles to the rachis, and the pinnules are 15 millimetres long and 7 broad.

This is a fine luxuriant species, of the general type of the widely distributed Jurassic species, *A. Whitbyanum*, and of its companion, *A. spectabile.*

Collected by G. M. D. at Martin Creek and North Fork, Old Man River.

Asplenium Dicksonianum, *Heer.* (Plate III. Fig. 1.)

Heer, Kreide Flora der Arctischen Zone, 1874, p. 31, Tab. I.

This species, which, according to Heer, is very abundant in the Lower Cretaceous of Greenland, is found at Crow's Nest Pass, near Canmore, and at Coal Brook; and is very plentiful in beds a little higher and belonging to the Intermediate series on the North Fork of Old Man River.

Collected by G. M. D.

Asplenium distans, *Heer.* (Plate III. Fig. 7.)

Heer, Jura Flora Ost-sibiriens. *Pecopteris recentior*, Phillips. *Neuropteris recentior*, Lindley and Hutton.

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[1] In subsequent descriptions only the initials, G. M. D., will be given in the case of specimens so collected.

The pinnules are rather larger, more narrow and more pointed upward than in Heer's specimens. It may be described as follows: Bipinnate, or tripinnate, pinnules elongate, free or united only at the base, lanceolate, slightly curved upward, 15 millemetres long and 4 to 5 broad, entire. Midrib slender, giving off veins at an acute angle and which are dichotomous. The species is widely distributed in time and space, and our specimens are probably of one of its varietal forms.

Collected by G. M. D. near Canmore, Rocky Mountains.

2. *Cycadaceæ.*

DIOONITES BOREALIS, *Dawson.* (Plate I. Fig. 2.)

Cretaceous and Tertiary Floras, Transactions of the Royal Society of Canada, Vol. I. Sec. IV. p. 24, Pl. III.

This species was described in the memoir above cited from a specimen collected by Mr. R. G. McConnell, at Willow Creek, in beds known to be Cretaceous, but of uncertain horizon. Additional specimens, collected at Martin Creek by Dr. G. M. Dawson, show that the frond contained twenty or more pairs of pinnules nearly at right angles to the midrib below, but above curving upward to an angle of 30°. The pinnules are 10 to 15 millimetres broad and with 15 to 26 veins.

This frond might be referred to the provisional genus, *Pterophyllum*, but its characters are so much those of *Dioon* that I have no hesitation in giving it the generic name indicating this affinity, and the association of Dioon-like fruits with similar leaves in the Lower Cretaceous of the Queen Charlotte Islands confirms the reference. The genus is elsewhere in the northern temperate regions characteristic of the Wealden and other beds at the base of the Cretaceous, but it extends into the Middle Cretaceous and still exists in Mexico.

Collected by G. M. D.

PODOZAMITES LANCEOLATUS, *Lindley.* (Plate I. Fig. 3.)

Zamia lanceolata, Lindley and Hutton.

Leaves undistinguishable from those of this world-wide species occur in all of the collections from the beds of the Kootanie group throughout its range, and contribute, by their abundance in some layers, to give a Jurassic character to the whole. It is regarded as a Jurassic type, though varieties or sub-species belonging to or allied to it extend into the Urgonian or Lower Cretaceous. This species has been recognised in England, in Sweden, in Siberia, in India, and in China; and Heer, apparently with reason, identifies with it *P. distans* and *P. Eichwaldii*, of Schimper, and *Zamites Haueri*, of Ettingshausen. The specimens from Martin Creek, and from Coal Creek, Crow's Nest Pass, are very good and characteristic, and belong to the ordinary variety. Var. *latifolia* occurs at Martin Creek, and a narrow variety at the Middle Branch of the North Fork of Old Man River. This may be regarded as the most characteristic form in the Kootanie series, and is the more valuable, as nothing resembling it is known to occur in the flora of the Upper Cretaceous.[1]

Collected by G. M. D. at Martin Creek, N. Kootanie Pass, etc.

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[1] In his Report of 1883, Lesquereux has noticed several leaflets from the Dakota group referable to this genus.

ZAMITES MONTANA, S. N. (Plate I. Figs. 6, 6A.)

Frond narrow, elongate, pinnate. Midrib strong and as broad as the pinnæ, which are contiguous, parallel-sided, very obtusely truncate, almost rounded at both extremities, thick and coriaceous, with four parallel veins, which are visible only on the under side. Ordinary size of pinnules 7 millimetres long and 2 millimetres broad. This is near to Heer's *Z. arctica* and *Z. brevipennis* from the Lower Cretaceous of Komé, Greenland, but has broader leaves than either, and is altogether larger. It is, perhaps, a variety proper to a more southern latitude.

Collected by G. M. D. at Martin Creek and Kootanie Pass.

ZAMITES ACUTIPENNIS, *Heer.* (Plate I. Fig. 5.)

Heer, Kreide Flora der Arctischen Zone.

This is a fragment of a frond, with pinnules not distinguishable from Heer's species, which is found in the Lower Cretaceous of Ekkorfat, Greenland.

Collected by G. M. D. at Martin Creek.

ZAMITES, Sp. (Plate I. Fig. 4.)

An imperfect leaf, like *Z. borealis* of Heer, as represented in Kreide Flora, Table XV, but too imperfect for certain determination.

Collected by G. M. D. at entrance to Kootanie Pass.

ANOMOZANITES ACUTILOBA? *Heer.* (Plate I. Fig. 7.)

Heer, Jurassic Flora, Ost-sibiriens, Pl. XXIV.

Pinnate, pinnæ broad and short, oblique, rounded at their extremities, contiguous, attached at base, with numerous parallel veins, at right angles to the petiole.

The fragments of this leaf indicate a form very near to *A. Schmidtii* and *A. acutiloba* from the Jurassic of Siberia, more especially to the latter.

Associated with these leaves are racemes of sessile fruits, referable to the genus *Cyadeocarpus*, and which may have belonged to this plant.

Collected by G. M. D. near Canmore.

SPHENOZAMITES, Sp.

A single imperfect leaflet in the shale of Martin Brook, indicates the presence of a cycadaceous plant, probably of this genus. The specimen resembles a leaflet of *S. latifolius*, Brongt, of the Upper Oolite.

Collected by G. M. D.

ANTHOLITHES HORRIDUS, *Dawson.*

Trans. Roy. Soc. Can., Vol. I. Sec. IV. p. 21, Pl. I. Fig. 3.

A few fragments of the radiating processes of this remarkable fruit indicate its presence in the beds at Middle Branch, North Fork, Old Man River. Without the perfect specimen from Peace River, described in my former paper, it would have been impossible to recognize these fragments.

Collected by G. M. D.

It will be observed that though some of the above species are represented by specimens too imperfect for detailed description, these are sufficient to establish their distinctness as species, and their reference to the Cycadeæ. We thus have evidence at the same point

of time and in the region extending along the Rocky Mountains, from the 49th to the 51st parallel, of no less than six species of Cycads belonging to at least four generic types; and these types are quite as much Jurassic as Cretaceous in their affinities. Thus we find the Jurassic flora continuing without a break into the Lower Cretaceous, and we shall find that in beds considerably above, we have the beginning of the Dicotyledonous plants of the Tertiary and Modern periods. Thus, in so far as the flora is concerned, the dividing line is in the middle of the Cretaceous; and we may speak of the flora of the Lower Cretaceous as Jurasso-Cretaceous, while that of the Upper members of the series will be Cretaceo-Eocene. Whether the long-enduring and widely-distributed flora, which we have designated by the former name, was strictly contemporary in all parts of its range, may be doubted, though its whole migrations were in this one definite period. It is not impossible that it may have been introduced first into the Arctic, and that in a time of insular land and equable climate, it made its way slowly south. These questions may, however, be better answered in the conclusion of the paper.

3. *Coniferæ.*

Salisburia (Ginkgo) Sibirica, *Heer.* (Plate II. Fig. 1.)

Heer. Jura Flora Ost-sibiriens. 1876, p. 61, Pl. VII.

" Leaf long, petiolate, palmate, frequently lobed, with 8 to 11 lobes, which are oblong and obtuse at their apices. Veins, for the most part 5 to 6, nearly parallel."

The leaf thus described by Heer, represents a group of lobate leaves, very widely distributed in the Jurassic and Wealden formations, and originally referred to the ferns, though Brongniart, from the first, owing to their hard and coriaceous texture, doubted the correctness of this reference. They were at first placed in the genus *Cyclopteris,* and the old *C. digitata,* Lindley, from the English Oolite is very near to the present species. They were afterwards removed to the doubtful genus, *Baiera,* and finally have come to be regarded as taxine leaves allied to those of the Ginkgo tree of Japan, a form represented at the present day by only a single species, limited to the Japanese Islands, but which, in Mesozoic and Tertiary times, possessed several species distributed over the whole of the Northern Hemisphere.

Collected near Martin Brook by G. M. D.

Salisburia (Ginkgo) lepida, *Heer.* (Plate II. Fig. 2.)

This species, or perhaps only varietal form, is distinguished by Heer, on account of its long and deeply-cleft lobes, attenuated at base and pointed at apex. It is very near to the *Baiera gracilis* of Bunbury, from the Yorkshire Oolite, and leaves closely allied are described by Dunker from the Wealden.

Locality, Martin Brook, and Coal Creek, G. M. D.

Salisburia (Ginkgo) nana, S. N. (Plate II. Fig. 3.)

Leaf small, of four narrow lobes, linear obtuse, and arranged in two pairs. Four subparallel veins in each lobe.

This little leaf appears to be distinct from the above species, unless, indeed, it may be a depauperated variety.

Collected by G. M. D. near Coal Creek.

SALISBURIA—Nuts of. (Plate II. Fig. 4.)

Ovate smooth nutlets like those of the modern Ginkgo, but smaller, abound in some of beds of the Kootanie series, and are doubtless the fruit of some of the above species.

BAIERA LONGIFOLIA, *Heer*. (Plate II. Fig. 5.)

Heer, Jura Flora Ost-sibiriens, p. 52, Pl. VIII.

Many fragments of leaves of a Baiera occur at Martin Creek. They indicate a species of the genus, and so far as the material avails, are not far from that above named. *Baiera dichotoma* and *B. cretosa*, which occur in the Lower Cretaceous of Greenland, are also allied forms. Plants of this genus have been placed by Heer among the Taxineæ, near to Salisburia, which, perhaps, represents their probable affinities as well as any other arrangement.

Collected by G. M. D.

PINUS SUSKWAENSIS, *Dawson*. (Plate II. Figs. 6, 6A.)

Dawson, Trans. Roy. Soc. Can., Vol. I. Sec. IV. p. 23, Pl. III. Fig. 37.

This species was described, in my former memoir above cited, from imperfect examples obtained at Suskwa River, the characters given being its long narrow linear leaves, about three inches in length, and borne about eight in a sheath. Many additional specimens both of detached leaves and bundles of leaves occur in the present collections. They shew that the prevalent number of leaves in a sheath was eight, that the leaves were as much as 8 centimetres in length, and that they were rigid, angled and one-nerved. The present species may be compared in age and appearance to *P. Nordenskioldii* from the Jurassic of Siberia, and to *P. Petersoni* from the Lower Cretaceous of Greenland. It is an interesting anticipation of the recent *Pinus strobus*, which it exceeds in the number of leaves in a sheath.

Collected by G. M. D. at Martin Creek, Coal Creek, Crow's Nest Pass.

Along with this species there are detached one-nerved leaves of broader form, which may have belonged to some other species of Pinus, or allied coniferous tree.

SEQUOIA SMITTIANA, *Heer*. (Plate II. Figs. 7, 7A.)

Heer, Kreide-flora der Arctishen Zone, Pls. XVII and XX.

"Branches elongate, leaves an inch long, rigid and coriaceous, linear, smooth, somewhat obtuse but acuminate, tending to a distichous arrangement, slightly narrowed at base, adnate-decurrent, mid-rib strong."

This species abounds in the Lower Cretaceous of Greenland, and is there the representative of *S. Langsdorffii* of the Tertiary, and of the modern *S. sempervirens*; but is a finer and more luxuriant species than either. After studying the specimens in the present collections, I am now convinced that the Sequoia from the Coal measures of Vancouver Island, hitherto referred to *S. Langsdorffii*, really belongs to this more luxuriant and better developed species. A cone probably of this species occurs in the collections from the Middle Fork, North Branch, Old Man River.

Large leafy branches collected by G. M. D. at Coal Creek, Crow's Nest Pass.

GLYPTOSTROBUS GRŒNLANDICUS, *Heer*, loc. cit. (Plate III. Fig. 8.)

Fragments not improbably of this species occur along with *Asplenium Dicksonianum* in

the collections from the North Branch, North Fork, Old Man River. The two species are also associated in the Lower Cretaceous of Greenland.

TAXODIUM CUNEATUM, *Newberry*. (Plate II. Fig. 8.)

Newberry, Later American Floras.

A small specimen referable to this species occurs in the collections from the Kootanie series. The species is described by Newberry from the Cretaceous of the west coast, and occurs in the coal measures of Vancouver Island.

4. *Incertæ Sedis.*

TAONURUS INCERTUS, S. N.

It seems doubtful if the objects referred to the above supposed genus of Algæ, are really organic or only concretionary. They have, however, evidently commended themselves to collectors in the west as probably fossils. The species in the present collection may be described as oval, with one deep furrow, and curved striæ proceeding to the margins. It may be a frond, a concretion, or the cast of a burrow like the Rusichnites of the Lower Silurian.[1]

Collected by G. M. D.

II.—INTERMEDIATE SERIES.

The plants thus indicated are from beds on the Middle Branch of the North Fork of Old Man River, supposed to be separated by a considerable interval of barren strata from the beds of the Kootanie series proper. They have afforded numerous specimens of the fern *Asplenium Dicksonianum*, also roots of Equiseta, with rounded tubercles, and branchlets of conifers which resemble *Glyptostrobus Groenlandicus*, Heer, and *Taxodium cuneatum*, Newberry. But their most marked characteristic is the occurrence of two species of Dicotyledonous leaves, which constitute in this region the earliest ascertained indications of plants of so high organisation.

STERCULIA VETUSTULA, S. N. (Plate III. Fig. 2.)

Leaf small, coriaceous, palmately three-lobed, lobes oblong, pointed, middle lobe one-third larger than lateral lobes; margin entire; a strong mid-rib in each lobe; nerves obsolete. Length about 4 centimetres.

I regard the generic name assigned to this leaf as entirely provisional. It has been given merely on account of its resemblance to leaves so named by previous writers. Such a leaf might have belonged to a plant referable, were its flowers and fruit known, to a very different group from to which Sterculia belongs.

Collected by G. M. D. at North Branch, North Fork, Old Man River.

LAURUS CRASSINERVIS, *Dawson*. (Plate III. Figs. 3, 3A.)

Trans. Roy. Soc. Can., Vol. I. Sec. IV. p. 23.

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[1] These are the so-called *Rusophycus* of authors, and have recently been reclaimed by Saporta and connected with Cruziana; but I have elsewhere in my Paper on Rusophycus (Canadian Naturalist), and in that on Footprints of Aquatic Animals (Silliman's Journal), advanced what I consider conclusive reasons to show that both Rusichnites and Cruziana are casts of furrows or trails of crustaceans and annellids.

Several fragments of crushed leaves are so similar to the leaf from Suskwa River, thus named in my former memoir, that I give them provisionally the same name. They resemble *L. Nebrascensis* and *L. Proteæfolia* of Lesquereux; but such leaves, so preserved, cannot with certainty be determined; and might be referred to a willow with perhaps as much probability as to a laurus.

Collected by G. M. D. with former species.

The main points of interest with respect to these leaves are that they represent two species and probably two genera of dicotyledonous trees or shrubs, with leaves of very moderate size and such as might occur in a temperate climate, and illustrating palmate and pinnate modes of venation.

III.—Mill Creek Series.

This is believed to be considerably higher in the Cretaceous than the previously mentioned series, though still within the limits of the Middle Cretaceous, and not improbably older than the Dunvegan group of the Peace River District, described in my former paper. It has important points of agreement with the Patoot series of Greenland, and the Dakota group of the Western United States.

1. *Filices.*

Gleichenia gracilis, *Heer*. (Plate III. Fig. 4.)

Heer, Kreide-flora der Arctischen Zone, p. 98.

" Frond small, slender, dichotomous, bipinnate; pinnæ approximate, lower spreading, upper erect; apex attenuate. Pinnules small, triangular, subfalcate, sori round, 1 or two on bases of pinnules."

The species thus characterized has an extensive range in Greenland.

Collected by G. M. D. and T. C. Weston[1] at Milk Creek.

Gleichenia Kurriana, *Heer*.

Lesquereux, Cretaceous Flora, p. 47.

This species, recognized by Lesquereux in the Dakota group, seems to be represented by mere fragments in Mr. Weston's collections from Mill Creek.

Dicksonia munda, S. N. (Plate III. Figs. 5, 5a.)

Frond pinnate, or bipinnate; barren pinnules with linear pointed arcuate pinnæ, narrowed at base and crenate at edges; less than 1 centimetre long. Fertile pinnules narrow with the marginal sori contiguous.

This is a beautiful and well-characterized fern, but unfortunately always in small fragments.

Asplenium albertum, S. N. (Plate III. Fig. 6.)

Bipinnate; pinnæ in upper part of frond elongate, dentate, in lower part pinnatifid with pointed pinnules, united at the bases and pointing upward. Traces of linear sori on the pinnules, which have few-branching veins.

Collected by T. C. W. at Mill Creek.

[1] T. C. W. in following pages.

2. *Cycadaceæ.*

WILLIAMSONIA RECENTIOR, S. N. (Plate IV. Fig. 1.)

Strobile globular or round-oval, about 3 centimetres in diameter, with numerous narrow curved pointed scales.

This fruit, of which there are several specimens in the collections from Mill Creek, resembles more nearly *Williamsonia Blandfordii*, Fiestmantel, from the Jurassic of India, than anything else I have seen.

3. *Coniferæ.*

The collections from Mill Creek are remarkably deficient in specimens of this order. A number of slender branchlets, imperfectly preserved in coarse stone, might be referred to the species *Glyptostrobus gracillimus* of Lesquereux, which also occurs in the Dunvegan group, Peace River, but which is very doubtfully referable to the genus *Glyptostrobus*. They might with just as much probability be referred to *Taxodium*, and as no fruit was found, it will probably be best to await the collection of additional specimens.

4. *Dicotyledones.*

ALNITES INSIGNIS ? *Dawson.*

Trans. Roy. Soc. Can., Vol. I. Sec. IV. p. 28, Pl. VIII.

Specimens, unfortunately very imperfect, in the collections from the North Fork of Old Man River, resemble the above species, which was found at Nanaimo, Vancouver Island, in the Upper Cretaceous. If not the same, they belong to an allied form.

PLATANUS HEERI, *Lesquereux.*

Lesquereux, Cretaceous Flora, p. 70, Pl. IX.

" Leaf rounded, bluntly three-lobed, margin entire or undulate, obliquely wedge-form toward petiole, and extending along it." Principal veins diverging at angles of 40° to 45°.

This is a species of the Dakota group.

Collected by T. C. W. at Mill Creek.

PLATANUS AFFINIS, *Lesq.* (Plate IV. Fig. 2.)

Leaf sub-coriaceous, round-hexagonal in outline, rounded margins narrowing in an angle to the petiole. Margin undulate or distantly dentate, venation pinnate, craspedodrome, central veins few, at a somewhat acute angle (about 35°). Lateral veins distant from margin, giving off curved craspedodrome veinlets to margin.[1]

This well marked species is equally characteristic of the Patoot series in Greenland and of the Dakota in the United States, and is one of the most abundant leaves in the collections of Dr. G. M. Dawson and Mr. Weston from Mill Creek and the Middle Branch, North Fork, Old Man River. It thus forms one of the most interesting links of connection between these floras.

PLATANUS AFFINIS, *var.* AMPLA.

Along with the above are leaves resembling it in general appearance, but differing in the wider angle of the principal veins, and in the comparative narrowness of the band of

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[1] Lesquereux's description, with slight verbal changes.

marginal veins. It may be a varietal form merely, or may represent a distinct species, and for the present I may characterize it as var. *ampla,* in the hope that more perfect specimens or intermediate forms may reveal its true nature.

LIQUIDAMBAR INTEGRIFOLIUM, *Lesquereux.*

Lesquereux, Cretaceous Flora, p. 56.

Mr. Weston's collection from Mill Creek contains a well-preserved specimen not distinguishable from the above species, which belongs to the Dakota group.

MACCLINTOCKIA CRETACEA, *Heer.* (Plate IV. Fig. 3.)

Heer, Flora Grœnlands, Patoot, Pl. LX.

Leaf membranous, five-nerved, narrowing to the base. Intermediate veins very delicate.

The specimens of this leaf are unfortunately imperfect, and it seems to have been of more delicate texture than most of the others. It agrees, however, with the Patoot species.

Collected by G. M. D. at Middle Branch, North Fork, Old Man River.

PROTEOIDES DAPHNOGENIOIDES, *Heer.*

Heer, Phyllites du Nebraska, p. 17.

Very numerous specimens represent an ovate lanceolate coriaceous one-nerved leaf, not distinguishable from the above, which was originally described by Heer from the Dakota group of Nebraska. Mixed with these, are other leaves of similar character and texture, having the form of *P. acuta* of Heer, but I think it probable that they may belong to the same species.

Collected by T. C. W. at Mill Creek.

CINNAMOMUM CANADENSE, S. N. (Plate IV. Fig. 7.)

Leaf coriaceous, entire, long ovate, narrowing to the base; three-veined from near the base, midrib stout.

This is near to *C. Sezannense,* Heer, which occurs at Patoot, Greenland, but is broader and with the veins at a wider angle. It is intermediate between the above species and *C. Heeri,* Lesq., from Vancouver Island, and of the Dakota group. All these may possibly be varieties of one species, as also may *C. Mississippiense* of the same author. (See his remarks, Cretaceous Flora, p. 84, and Cretaceous and Tertiary Floras, p. 54.) The reference of these leaves to the genus *Cinnamomum* will admit of doubt, till evidence can be obtained as to their fruit.

LAUROPHYLLUM DEBILE, *Dawson.*

Trans. Roy. Soc. Can., Vol. I. Sec. IV. Pl. II. Fig. 7.

Leaves referable to this species, originally collected in the Dunvegan group, Peace River, appear in the collections from Middle Branch, North Fork, Old Man River. (In the figure above referred to, the midrib is much exaggerated in thickness.)

Collected by G. M. D.

LAURUS CRASSINERVIS, *Dawson.*

This species, already mentioned as occurring in the Kootanie series, seems still to survive in the Mill Creek period.

Collected by G. M. D.

Aralia, Sp.

Fragments of a large leaf which may be *A. Saportana*, Lesq., but is too imperfect for certain determination.

Collected by G. M. D. at Middle Branch, North Fork, Old Man River.

Aralia rotundata, S. N. (Plate IV. Fig. 5.)

Leaf large, 7 centimetres long, with five strongly marked ribs at angles of about 20°. General form broad cuneate or fan-shaped, with five rounded terminal lobes.

Collected by T. C. W. at Mill Creek.

Aralia Westonii, S. N. (Plate IV. Fig. 6.)

Leaf five-parted and five-veined, basal angle approaching to 90°. Central lobe lanceolate, much larger than next lobes, and these larger than lateral lobes. Surface shining and coriaceous.

Abundant in Mr. Weston's collections from Mill Creek. The generic name is quite conjectural, as the finer textures of the leaf are not apparent. At first sight, in size and general aspect, the leaves resemble those of *Acer campestre*, but are different in details.

Hedera ovalis? *Lesquereux.*

Lesquereux, Cretaceous Flora, p. 91.

Form circular to round oval, venation of hederaceous type, and so much like that of the species above named that I think it may safely be referred to it.

Collected by T. C. W. at Mill Creek.

Magnolia magnifica, *Dawson.*

Dawson, Trans. Roy. Soc. Can., Vol. I. Sec. IV.

A large leaf in Mr. Weston's collections from Mill Creek is similar in form to the leaf of the Peace River species above named, but the venation is not preserved.

Paliurus montanus, S. N.

Leaf large, about 8 centimetres long, membranous, oblong or long-ovate, entire, three-ribbed, but middle rib greatly dominant and sending off curved veins toward apex; lateral veins slender, near the margin and curved parallel with it.

This genus is represented by species different from the above in the Dakota group and in Greenland. It seems difficult to distinguish fossil leaves of this type from those of the allied genus *Ceanothus.*

Collected by G. M. D. at Middle Branch, North Fork, Old Man River.

Paliurus ovalis, S. N. (Plate IV. Figs. 4 and 8.)

Ordinary leaf five centimetres long, and 2.5 wide, almost perfectly elliptical, but a little more obtuse at apex than at base. Mibrib strong, lateral veins very faint, in some specimens obsolete.

These leaves differ little in form from *P. membranaceus*, Lesquereux, from the Dakota group, but are more coriaceous.

Collected by T. C. W. at Mill Creek.

Juglandites cretacea, S. N.

Leaf small, oval, crenate or bluntly toothed, membranous, with four pairs of veins, curving in a camptodrome manner. Surface rough, ordinary length 4.5 centimetres.

Collected by G. M. D. at Middle Branch, North Fork, Old Man River.

IV.—Belly River and Laramie Series.

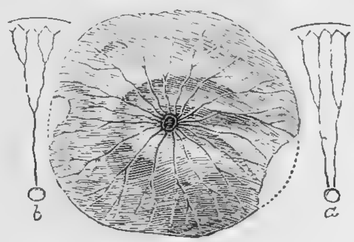
I do not propose in this paper to enter into a detailed description of the species from the Belly River and Laramie beds now in my hands, but merely to state a few facts supplementary to those in former reports and papers, and in anticipation of fuller descriptive lists which I hope to prepare in the future.

Since the publication of my memoir of 1883, I have myself, with the kind aid of Mr. Moses Burpee, then of Calgary, made considerable collections in the railway cuttings at Shaganappi Point, on Bow River, a few miles west of Calgary. Mr. S. R. Byrom, of Drylesden, England, has kindly presented me with an interesting new species from the Belly River series of the South Saskatchewan, and Mr. Weston and Mr. Tyrrell, of the Geological Survey, have made some valuable collections from the Belly River series and the Lower Laramie, which have been placed in my hands by the Director of the Geological Survey. In connection with this, the recent report of Dr. G. M. Dawson has given us, for the first time, a subdivision of the Laramie beds, and the local distribution of the several members.

It is expected that additional specimens will be collected in the summer of 1885, and that it may be possible, next year, to present a somewhat complete account of the Laramie flora and its several subdivisions, and also of the relations of this flora to that of the beds underlying. In the meantime, I shall here give notices of the more interesting new species in the recent collections, and shall notice their stratigraphical distribution in the next section.

Brasenia antiqua, S. N.

Leaves rounded elliptical, entire. Insertion of petiole nearly in the centre, with about eighteen radiating veins forking about half-way to the margin, and a second time near the margin, to join the marginal areolation. Form somewhat less elliptical than in the modern *B. peltata*, and veins more numerous, but otherwise similar.



Brasenia antiqua, Upper Cretaceous, South Saskatchewan River. Leaf natural size. *A*, *b*, Diagrams of Venation, slightly enlarged.

The specimens were obtained in the beds of the Belly River series of the Canadian Survey, near Medicine Hat. These beds are Upper Cretaceous, and hold fossils, some of which resemble those of the Laramie group, others those of the Pierre group. I place their fossil plants with those of the Laramie, because the flora seems to be in the main similar to that of the Lower Laramie. They contain workable beds of lignitic coal; and

the specimens in question were found in nodular clay ironstone, associated with one of the coal beds worked in the Lawson Mine.

A specimen of this interesting fossil, obtained, I believe, from Mr. Lawson, the manager of the mine, was kindly given to me last year by Mr. J. R. Byrom, one of the members of the British Association; and additional specimens, some of them very perfect, were afterwards collected by Mr. T. C. Weston of the Geological Survey.

The modern *Brasenia peltata* is said to occur in British Columbia, Japan, Australia and India, as well as in Eastern America. Not being acquainted with its range of variation in these countries, I cannot certainly affirm that the present specimens are specifically distinct. They may represent merely an ancient varietal form.

In the same bed holding these leaves are other aquatic plants, as *Pistia corrugata*, Lesq., *Lemna scutata*,[1] Dn., *Trapa*? There are also fragments of the great leaves of *Platanus nobilis* and the Populus and Acer described below.

Populus latidentata, S. N.

Base unequally pointed. Margin entire for some distance from base, then with rounded obtuse teeth. Leaf broad above and probably obtuse at apex. The marginal teeth are about the size of those of the modern *P. grandidentata*, but more obtuse, and the leaf resembles in form and size the smaller and narrower leaves of the modern species, to which also it conforms in the character of its venation.

In the same matrix with the above are fragments of leaves of another Populus, of the type of *P. acerifolia*, Newberry.

Collected by T. C. W. in Belly River series, near Medicine Hat.

Acer Saskatchewense, S. N.

Leaf small, unequally tri-lobed, with the central lobe much longer than the others, and the larger lateral lobe slightly notched, with a rudiment of an additional lobe. Length about 4 centimetres. Width much less than length.

This may be a terminal leaflet of a Negundo, but there were no indications of lateral leaves connected with the specimens, and it resembles very nearly the young leaves of *Acer dasycarpum*.

Collected by T. C. W. in Belly River series, near Medicine Hat.

Trapa borealis, *Heer*.

This species was recognized by me in 1878, in the collections of Dr. G. M. Dawson from the vicinity of the 49th parallel, in beds probably belonging to the Lower Laramie. Fruits only were found. More recently Lesquereux has found in beds, probably of Laramie age, leaves which he attributes to this genus, and which may possibly belong to the present species. In Mr. Tyrrell's collections from Red Deer River, are fruits similar to those previously described, and also leaves similar to those described by Lesquereux (*Trapa microphylla*). The leaf may be described as ovate-flabellate in form, rounded at base, straight at the diverging sides, and at the end with very shallow rounded sinuses, separating short teeth, which in some specimens are nearly obsolete.

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[1] The nature and affinities of this curious plant I shall hope to discuss, with the aid of the new specimens, in a future paper.

Collected by R. B. Tyrrell in the Lower Laramie, at the Red Deer and Rosebud Rivers. This plant is associated at several localities with Pistia and Lemna, and in this respect the beds holding it conform in their flora to the Belly River series on the South Saskatchewan. The same remark applies to the beds at Pincher Creek, Berry Creek, etc., from which places small collections have been obtained.

ABIETITES TYRRELLII, S. N.

Branches stout, with broad and thick leaves, spirally disposed, showing no ribs, and slightly narrowing and decurrent on prominent leaf-bases.

Fine casts of this plant occur in hard clay ironstone at Berry Creek. Collected by R. B. Tyrrell.

SALISBURIA.

Seeds or nutlets referable to this genus were observed in the collections from several places in the Lower Laramie.

The above are all from the Belly River series or the Lower Laramie, in which also occur abundant remains of a Sequoia which I have referred to *S. Reichenbachii.* The remaining species are from the Upper Laramie or Porcupine Hill series.

PLATANUS NOBILIS, *Newberry.*

Newberry, Later Extinct Floras of America.

Large numbers of these fine leaves occur in the Upper Laramie sandstone near Calgary. They show that the peculiarities of venation referred to by Lesquereux in his notice of this species, are only varietal. The leaves from Calgary exhibit the auricles or supplementary leaflets first described by me in the specimens collected by Dr. Selwyn at Souris (Geol. Survey of Canada, 1879.)

PLATANUS RAYNOLDSII, *Newberry.*

Newberry, *loc. cit.*

This species is also abundant and mixed with the former, at Shaganappi Point, near Calgary. Its leaves present many differences in size and form, but these pass into one another.

POPULUS.

In the same beds with the above, are leaves of several species of Poplar, which I refer provisionally to *P. acerifolia, P. genetrix* and *P. cordifolia,* of Newberry.

SASSAFRAS (ARALIOPSIS) BURPEANA, S. N.

Leaf three-lobed, long petioled, lateral ribs at angle of about 30° to middle rib. Secondary veins very strong, the inner ones joining at an obtuse angle in the palm of the leaf. Leaf probably trifid at apex, and somewhat rounded and auriculate at base.

Collected by Mr. Burpee near Calgary, Upper Laramie sandstone.

VIBURNUM OXYCOCCOIDES, S. N.

Leaf large, tri-lobed, central lobe long and acute, lateral lobes rounded at margin. Auriculate with two small rounded leaflets at base. Venation almost precisely as in the

modern *Viburnum opulus*, and the leaf is scarcely distinguishable from leaves of that species taken from young and vigorous shoots, except in the auricles at the base.

Collected by G. M. D. at Shaganappi Point, near Calgary.

VIBURNUM CALGARIANUM, S. N.

Leaf simple, nearly round, obtusely toothed at margin. Venation as in *V. rotundifolium*, Lesquereux, except that the ultimate venation is much coarser. The marginal teeth are also much more rounded, being merely waves of the edge.

This leaf is very near in general appearance to that described in my former memoir as *Alnites insignis*, from the Cretaceous of Vancouver Island. I believe, however, it is quite distinct.

Collected by G. M. D. at Shaganappi Point, near Calgary, Upper Laramie.

In the same beds with the above species are oval drupelets of the structure of those of Viburnum, and which may have belonged to the same plants from which the leaves were derived.

SALISBURIA, Sp.

Fragments of a flabellate leaf, similar in form and size to that of the modern ginkgo, and also nutlets, occur in the sandstones of Shaganappi Point.

V.—GEOLOGICAL RELATIONS OF THE FLORAS.

In my memoir in the first volume of the Transactions of this Society, I have given a table of the Cretaceous formations of the western Northwest Territories of Canada, prepared by Dr. G. M. Dawson, and have fully stated the geological position of the plants at that time described. The new facts above detailed now require us to intercalate in our table three distinct plant-horizons not previously recognized in the western territories of Canada. One of these, the Kootanie series, should probably be placed at the base of the table as a representative of the Urgonian or Neocomian, or, at the very least, should be held as not newer than the Shasta group of the United States Geologists, and the Lower Sandstones and Shales of the Queen Charlotte Islands. It would seem to correspond in the character of its fossil plants with the oldest Cretaceous floras recognized in Europe and Asia, and with that of the Komé formation in Greenland, as described by Heer. No similar flora seems yet to have been distinctly recognized in the United States, except, perhaps, that of the beds in Maryland, holding cycads, and which were referred many years ago by Tyson to the Wealden.

The second of these plant-horizons, separated according to Dr. G. M. Dawson, by a considerable thickness of strata, is that which he has called the Mill Creek series, and which corresponds very closely with that of the Dakota group, as described by Lesquereux, and that of the Atané and Patoot formations in Greenland, as described by Heer. This fills a gap, indicated only conjecturally in the table of 1883. Along with the plants from the Dunvegan group of Peace River, described in 1883, it would seem to represent the flora of the Cenomanian and Turonian divisions of the Cretaceous in Europe.

Above this we have also to intercalate a third sub-flora, that of the Belly River series at the base of the Fort Pierre group. This, though separated from the Laramie proper by

the marine beds of the Pierre and Fox Hill groups, more than 1,700 feet in thickness, introduces the Laramie or Danian flora, which continues to the top of the Cretaceous, and probably into the Eocene, and includes several species still surviving on the American continent, or represented by forms so close that they may be varietal merely.

Lastly: the subdivision of the Laramie group, in the last report of Dr. G. M. Dawson, into the three members known respectively as the Lower or St. Mary River series, the Middle or Willow Creek series, and the Upper or Porcupine Hill series, in connection with the fact that the fossil plants occur chiefly in the lower and upper members, enables us now to divide the Laramie flora proper into two sub-floras,—an older, closely allied to that of the Belly River series below; and a newer, identical with that of Souris River, described as Laramie in Dr. G. M. Dawson's Report on the 49th Parallel, 1876, and in the Report of the Geological Survey of Canada for 1879, and which appears to agree with that known in the United States as the Fort Union group, and in part at least with the so-called Miocene of Heer from Greenland.

From the animal fossils and the character of the flora, it would seem probable that the rich flora of the Cretaceous coal fields of Vancouver Island is nearly synchronous with that of the coal-bearing Belly River series of the western plains.

It will thus be seen that the explorations already made in Canadian territory have revealed a very complete series of Cretaceous plants, admitting, no doubt, of large additions to the number of species by future discoveries, and also of the establishment of connecting links between the different members, but giving a satisfactory basis for the knowledge of the succession of plants and for the determination of the ages of formations by their vegetable fossils.

In connection with the subjoined table it should be understood that Tertiary floras, probably Miocene in age, are known in the interior of British Columbia, though they have not yet been recognized in the territories east of the Rocky Mountains.

Before leaving this part of the subject, I would deprecate the remark which I see occasionally made, that fossil plants are of little value in determining geological horizons in the Cretaceous and Tertiary. I admit that in these periods some allowance must be made for local differences of station, and also that there is a generic sameness in the flora of the Northern Hemisphere, from the Cenomanian to the modern, yet these local differences and general similarity are not of a nature to invalidate inferences as to age. No doubt so long as palæobotanists seemed obliged, in deference to authority, and to the results of investigations limited to a few European localities, to group together, without distinction, all the floras of the later Cretaceous and earlier Tertiary, irrespective of stratigraphical considerations, the subject lost its geological importance. But when a good series has been obtained in any one region of some extent, the case becomes different. Though there is still much imperfection in our knowledge of the Cretaceous and Tertiary floras of Canada, I think the work already done is sufficient to enable any competent observer to distinguish by their fossil plants the Lower, Middle and Upper Cretaceous, and the latter from the Tertiary; and, with the aid of the work already done by Lesquereux and Newberry in the United States, to refer approximately to its true geological position any group of plants from beds of unknown age in the west.

The successive series may be tabulated as follows, with references for details to the fuller table in my memoir of 1883:—

SUCCESSIVE FLORAS AND SUB-FLORAS OF THE CRETACEOUS IN CANADA.

(IN DESCENDING ORDER.)

PERIODS.	FLORAS AND SUB-FLORAS.	REFERENCES.
Transition Eocene to Cretaceous.	Upper Laramie or Porcupine Hill Series.......	Platanus beds of Souris River and Calgary. Report Geol. Survey of Canada for 1879, and present memoir.
Upper Cretaceous (Danian and Senonian.)	Middle Laramie or Willow Creek Series.	
	Lower Laramie or St. Mary River Series......	Lemna and Pistia beds of bad lands of 49th Parallel, Red Deer River etc., with Lignites. Report 49th Parallel and this memoir.
	Fox Hill Series	Marine.
	Fort Pierre Series	Marine.
	Belly River Series. (See note)..............	Sequoia and Brasenia beds of S. Saskatchewan, Belly River, etc., with Lignites. This memoir.
	Coal Measures of Nanaimo, B.C., probably here.	Memoir of 1883. Many Dicotyledons, Palms, etc.
Middle Cretaceous (Turonian and Cenomanian.)	Dunvegan Series of Peace River. (See note)...	Memoir of 1883. Many Dicotyledons, Cycads, etc.
	Mill Creek Series of Rocky Mountains........	Dicotyledonous leaves, similar to Dakota Group of the U. S. This memoir.
Lower Cretaceous (Neocomian, &c.)	Suskwa River and Queen Charlotte Island Series. Intermediate Series of Rocky Mountains......	Cycads, Pines, a few Dicotyledons. Report Geol. Survey. This memoir.
	Kootanie Series of Rocky Mountains..........	Cycads, Pines and Ferns. This memoir.

NOTE.—Though the flora of the Belly River series very closely resembles that of the Lower Laramie, showing that similar plants existed throughout the Senonian and Danian periods in North America, yet it is to be anticipated that specific differences will develop themselves in the progress of discovery. In the mean time it scarcely seems possible to distinguish by fossil plants alone the Lower Laramie beds from those of Belly River, and if these are really separated by 1,700 feet of marine strata, as is now believed on stratigraphical grounds, the flora must have been remarkably persistent. The Dunvegan series of Peace River probably corresponds in time with the marine Niobrara and Benton groups farther south and the Mill Creek with the Dakota group.

VI.—PHYSICAL CONDITIONS AND CLIMATE INDICATED BY THE CRETACEOUS FLORAS.

In the Jurassic and earliest Cretaceous periods the prevalence, over the whole of the Northern Hemisphere and for a long time, of a monotonous assemblage of Gymnospermous and Acrogenous plants, implies an uniform and mild climate and facility for intercommunication in the north. Toward the end of the Jurassic and beginning of the Cretaceous, the land of the Northern Hemisphere was assuming greater dimensions, and the climate probably becoming a little less uniform. Before the close of the Lower Cretaceous periods the dicotyledonous flora seems to have been introduced, under geographical conditions which permitted a warm-temperate climate to extend as far north as Greenland.

In the Cenomanian, we find the Northern Hemisphere tenanted with dicotyledonous trees closely allied to those of modern times, though still indicating a climate much warmer than that which at present prevails. In this age, extensive but gradual submergence of land is indicated by the prevalence of chalk and marine limestones over the surface of

both continents; but a circumpolar belt of land seems to have been maintained, protecting the Atlantic and Pacific basins from floating ice, and permitting a temperate flora of great richness to prevail far to the north, and especially along the southern margins and extensions of the circumpolar land. These seem to have been the physical conditions which terminated the existence of the old Mesozoic Flora and introduced that of the Middle Cretaceous.

As time advanced, the quantity of land gradually increased, and the extension of new plains along the older ridges of land was coincident with the deposition of the great Laramie series, and with the origination of its peculiar flora, which indicates a mild climate and considerable variety of station in mountain, plain and swamp, as well as in great sheets of shallow and weedy fresh water.

In the Eocene and Miocene periods the continent gradually assumed its present form, and the vegetation became still more modern in aspect. In that period of the Eocene, however, in which the great nummulitic limestones were deposited, a submergence of land occurred on the Eastern continent which must have assimilated its physical conditions to those of the Middle Cretaceous. This great change, affecting materially the flora of Europe, was not equally great in America, which also by the north and south extension of its mountain chains permitted movements of migration not possible in the Old World. From the Eocene downward, the remains of land animals and plants are found only in lake basins occupying the existing depressions of the land, though more extensive than those now remaining. It must also be borne in mind, that the great foldings and fractures of the crust of the earth which occurred at the close of the Eocene, and to which the final elevation of such ranges as the Alps and the Rocky Mountains belongs, permanently modified and moulded the forms of the continents.

These statements raise, however, questions as to the precise equivalence in time of similar floras found in different latitudes. However equable the climate, there must have been some appreciable difference in proceeding from north to south. If, therefore, as seems in every way probable, the new species of plants originated on the Arctic land and spread themselves southward, this latter process would occur most naturally in times of gradual refrigeration or of the access of a more extreme climate, that is in times of the elevation of land in the temperate latitudes, or conversely, of local depression of land in the Arctic, leading to invasions of northern ice. Hence the times of the prevalence of particular types of plants in the far north would precede those of their extension to the south, and a flora found fossil in Greenland might be supposed to be somewhat older than a similar flora when found farther south. It would seem, however, that the time required for the extension of a new flora to its extreme geographical limit, is so small in comparison with the duration of an entire geological period, that practically, this difference is of little moment, or at least does not amount to antedating the Arctic flora of a particular type by a whole period, but only by a fraction of such period.

It does not appear that, during the whole of the Cretaceous and Eocene periods, there is any evidence of such refrigeration as seriously to interfere with the flora, but perhaps the times of most considerable warmth are those of the Dunvegan group in the Middle Cretaceous and those of the later Laramie and oldest Eocene.

It would appear, that no cause for the mild temperature of the Cretaceous needs to be invoked, other than those mutations of land and water which the geological deposits them-

selves indicate. A condition for example of the Atlantic basin in which the high land of Greenland should be reduced in elevation and at the same time the northern inlets of the Atlantic closed against the invasion of Arctic ice, would at once restore climatic conditions allowing of the growth of a temperate flora in Greenland. As Dr. Brown has shown,[1] and as I have elsewhere argued, the absence of light in the Arctic winter is no disadvantage, since, during the winter, the growth of deciduous trees is in any case suspended, while the constant continuance of light in the summer is, on the contrary, a very great stimulus and advantage.

It is a remarkable phenomenon in the history of genera of plants in the later Mesozoic and Tertiary, that the older genera appear at once in a great number of specific types, which become reduced as well as limited in range down to the modern. This is no doubt connected with the greater differentiation of local conditions in the modern; but it indicates also a law of rapid multiplication of species in the early life of genera. The distribution of the species of *Salisburia*, *Sequoia*, *Platanus*, *Sassafras*, *Liriodendron*, *Magnolia*, and many other genera, affords remarkable proofs of this.

Gray, Saporta, Heer, Newberry, Lesquereux and Starkie Gardner, have all ably discussed these points; but the continual increase of our knowledge of the several floras, and the removal of error as to the dates of their appearance must greatly conduce to clearer and more definite ideas. In particular, the prevailing opinion that the Miocene was the period of the greatest extension of warmth and of a temperate flora into the Arctic, must be abandoned in favour of the later Cretaceous and Eocene; and if I mistake not, this will be found to accord better with the evidence of general geology and of animal fossils.

NOTE.—While this memoir was passing through the press, the Report of Mr. Whiteaves, F. G. S., Palæontologist to the Canadian Survey, on the invertebrate fossils of the Laramie and Cretaceous of the Bow and Belly River districts appeared. (Contributions to Canadian Palæontology, Vol. i. Part 1, 89 pages and eleven plates). This valuable Report constitutes an independent testimony, based on animal fossils, to the age of the beds in question, and accords in the main very closely with the conclusions above derived from fossil plants. Unfortunately, however, no animal remains have yet been found in the Kootanie series, and the only fossil recorded from the Mill Creek beds is a species of *Inoceramus*, characteristic in the United States of the Niobrara and Benton groups, a position a little higher than that deduced from the plants.

[1] Florula Discoana.

II.—*On the Wallbridge Hematite Mine, as illustrating the Stock-formed Mode of Occurrence of certain Ore-Deposits.* By E. J. CHAPMAN, Ph. D., LL.D.

(Read May 28, 1885.)

Metalliferous deposits, viewed broadly, may be regarded as falling under the following sub-divisions: Veins, stocks, net-works, gash-lodes, impregnations, beds, alluvions. Briefly defined, without regard to accidental or local conditions, these are characterized as follows:—

VEINS are ancient fissures filled up, forming, as a rule, comparatively narrow sheets of mineral matter, which commonly pass through various kinds of rock without regard to the strike or dip of these, and which, normally, extend downward to great depths.

STOCKS are limited masses of ore, although often of large dimensions, lenticular or irregular in form, and inclined or horizontal in position. In some cases, they conform more or less to the structural characters of the rocks in which they occur; in other and perhaps the majority of cases, they shew no relations of this kind, but occupy a totally independent position as regards the enclosing rock.

NET-WORKS, sometimes called STOCK-WORKS, are assemblages of narrow, reticulating veins, branching irregularly through the enclosing rock, and commonly tapering off and dying out in thin strings.

GASH-LODES are simply narrow, often more or less linear, stocks, usually of short length, but commonly occurring in closely adjacent parallel bands, thus resembling a series of short, broken veins. As a rule, they consist wholly of metallic matter, without any accompanying veinstone or trace of vein structure.

IMPREGNATIONS consist of metallic matters diffused through zones or areas of rock in small, often imperceptible, particles, or in patches or stains. Impregnations or diffusions of this kind are occasionally of independent occurrence; but more commonly they occur in intimate connection with veins, stocks, or other ore-deposits, being evidently emanations from these, or otherwise due to similar causes.

BEDS are deposits of mineral matter lying parallel, or practically parallel, with the stratification or foliation of the rocks in which they occur, and never extending upward in strings or other prolongations into the overlying rock, as they are necessarily of earlier deposition than the latter.

ALLUVIONS cannot strictly be separated from beds proper, as they are simply beds or bedded deposits of more or less superficial occurrence, but for practical purposes they are conveniently classed apart. They consist of accumulations, from springs, streams and rivers, of detrital or precipitated matters in which metallic substances or other economic products are present.

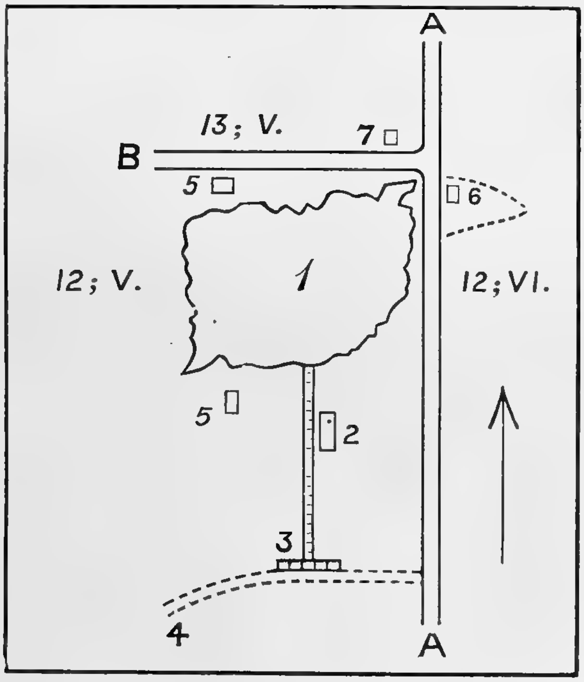
As regards Canadian iron ores, the existence of stock-formed deposits hardly seems to have been recognized, if recognized at all, in the earlier explorations of the country. Many of our iron-ore deposits, perhaps the majority, are nevertheless in that condition. In the

examination of a deposit of iron ore, as revealed by natural exposures, or laid bare by trenches or trial-pits, the presence of a stock-formed mass may be inferred in most cases from the great width of the deposit, and especially—whether of abnormal width, or otherwise—by the variations in width, and consequent irregularity of outline, which it exhibits. In the case of magnetic ores, these indications are often sufficiently revealed by the dipping-needle.

A very instructive and unmistakable example of a stock-formed ore-deposit is furnished by the Wallbridge Hematite Mine, on the twelfth lot of the fifth range or concession of Madoc, one of the southern townships of the County of Hastings, in Ontario. This mine, now practically exhausted, was opened about sixteen years ago by the late Thomas Campbell Wallbridge of Belleville. Since that date, with occasional stoppages, it has been extensively worked, and has yielded many thousand tons of red iron ore of very superior quality.

The geological features of the district in which the mine occurs were indicated briefly by Mr. Thomas Macfarlane in his Report on the County of Hastings, published by the Geological Survey in 1866, and more elaborately by the late Mr. Vennor in his able Report of 1869; but as the mine had not been opened at these dates, no information could at that time be given as regards the nature and extent of the deposit. It was previously known that the rock formations of the district are essentially of Laurentian age, overlaid, here and there, unconformably, by outlying patches of Lower Silurian limestone, now called " Cambro-Silurian " by the present Survey. According to Mr. Vennor, the Laurentian rocks of this section of country form a series of roughly-parallel synclinals with general N E and S W strike, and consist of a threefold subdivision, comprising (in ascending order): (1) syenitic and gneissoid rocks, essentially red in colour, with some crystalline, graphitic limestones; (2) dark-green, amphibolic and pyroxenic rocks with associated iron ores; and (3) various micaceous and siliceous slates, crystalline limestones, and conglomerates, mostly of a greyish colour. Whilst the general accuracy of this distribution is undeniable, I think it would be preferable to regard the series as consisting of four, in place of three, groups,—two of these being probably eruptive or intrusive, while the other two are undoubtedly metamorphic strata in the ordinary sense of the term. I would thus separate, from the lower stratified gneisses, the unstratified syenites or syenitic granites, the elevation of which has caused the synclinals determined by Mr. Vennor. The green, amphibolic or pyroxenic rocks are of doubtful origin. Although in places they graduate into schistose layers apparently conformable with the underlying gneisses, in other places they shew no distinct stratification, and at certain spots, as pointed out by Mr. Macfarlane, they present even a sub-columnar structure. I believe them to be for the greater part, if not wholly, eruptive overflows or intrusive beds from which the iron deposits have separated during consolidation. In many places they are scarcely represented at all in the series, or merely form the sheaths or enclosing rock of the iron ore. They differ, thus, in a very marked manner from the extended gneissoid beds which lie beneath them, and from the slates, crystalline limestones, etc., by which they are immediately succeeded. Here and there throughout the district, these crystalline rocks are overlaid unconformably by outlying patches of fossiliferous and nearly horizontal limestones of the Lower Trenton horizon. The elevation of the red syenites, therefore, if Post-Laurentian, must necessarily have preceded the Cambro-Silurian period.

The position of the hematite deposit, forming the Wallbridge Mine, is at the summit of the lower gneissic series, or immediately at the base of the upper series. The mine, itself, occurs on the twelfth lot of the fifth concession of Madoc, about four miles north of Madoc village. The ore, now exhausted, was in the form of a large " stock " or irregular mass, partly encased in and mixed with green amphibolic rock; but the latter is very sparingly present at this locality, and, as shewn by shafts immediately adjacent to the mine, it does not extend many yards beyond the site of the ore. The hematite has been mined by open quarrying, and the large excavation which has thus resulted shows the original mass of ore to have averaged about 170 feet in length, by about 100 feet in breadth, with an average depth of eighty feet. The weight of this mass would exceed 200,000 Canadian tons. Here and there, as in stock-formed masses generally, the ore has thrown out wedge-shaped prolongations into the surrounding rock ; but these, when followed up, have been found, in every instance, to terminate more or less abruptly at distances of a few feet or yards. The floor of the excavation is now on bare rock, but in order to test the pit thoroughly, the lessees have sunk upon it a couple of small shafts, seventy-five feet apart, and about thirty feet deep, and these have been connected at the bottom by a narrow drift. The latter passed through barren ground, all the way.



EXPLANATION :

A, A, COUNTY ROAD. B, SIDE ROAD. 1. LARGE EXCAVATION LEFT BY REMOVAL OF ORE AT THE WALLBRIDGE MINE, ON LOT TWELVE, CONCESSION FIVE, MADOC. 2. ENGINE HOUSE. 3. SHOOT. 4. TRAMWAY. 5, 5. SHEDS. 6. SHAFT OF MILLER MINE ON LOT TWELVE, CONCESSION SIX. 7. SHAFT ON LOT THIRTEEN, CONCESSION FIVE.

It was at one time thought that the deposit extended across the country road, in an easterly direction, into the twelfth lot of the sixth concession ; but although there are undoubtedly, indications of a slight extension in this direction, subsequent explorations

have shewn that, both here and in the main pit, the ore is practically exhausted. No. 6, in the annexed sketch-plan, indicates the position of a shaft sunk on this supposed extension to a depth of nearly seventy feet. Drifts were run in an easterly and westerly direction, to a distance of about twenty feet from the bottom of the shaft. These workings were known as the Miller Mine; but in one drift little more than poor, fragmentary ore and iron-stained rock was met with, and in the other the indications were not sufficient to warrant further outlay. No. 7 shews the position of another shaft, sunk (against advice) to about the same depth of seventy feet, immediately north of the Wallbridge pit, on the thirteenth lot of the fifth concession. This passed through some light-grey crystalline limestone and then entered the underlying gnessic strata, meeting only with a small string of hematite, and with little more than traces of amphibolic rock.

A sample of ore taken some time ago from the body of the Wallbridge pit, contained by my analysis 97.18 per cent. ferric oxide, equivalent to 68 per cent. metal, with only 2.78 per cent. amphibolic rock-matter; whilst the best sample that I could get from the bottom of the Miller shaft[1] contained 23.43 per cent. rock-matter with much free silica in it, and a second sample held no less than 29.32 per cent. rock-matter.

As the working of all stock-formed deposits must necessarily be followed sooner or later by the exhaustion of the ore, and as no surface indications will enable one to predict with any certainty the amount of ore present in a stock-formed mass, greater caution than usual is required in handling these deposits. Happily, in the diamond drill, we have the means of testing rapidly and economically the dimensions and general purity of ore-masses of this character. By a few borings put down at short distances beyond the visible or supposed limits of the deposit, and in the central part of the deposit itself, not only can its dimensions be safely ascertained, but the cores of ore brought up by the drill will afford a thorough insight into the character of the deposit, from depth to depth, throughout its entire mass.

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[1] At the date of my visit to this so-called mine, the drifts were entirely closed, so that I could not get into them.

III.—*Geology of Cornwallis or McNab's Island, Halifax Harbour.*

By REV. D. HONEYMAN, D.C.L.

(Read May 28, 1885.)

This, with Lawlor's Island, divides the entrance to Halifax Harbour into two parts, the main and eastern passages. The only distinct geological formation of which it is constituted is the Post-Pliocene or glacial drift. On its inner or north side is apparently a small outcrop of Cambrian argillites, similar to those of Point Pleasant opposite. There is also a rock off Lighthouse Point, which is seen at low water. To the east of this, on the elevated ground, at the end of Lighthouse Beach, an outcrop of quartzite appears. These seem to be continuations of the rocks of York Redoubt, on the west of the main entrance. The elevation of the interior of the Island, 152, 145, 113 feet, indicates the existence of a solid centre.

The glacial drift is well exposed, in shore sections, along the west side of the Island. Some of these have a height of twenty or thirty feet. They are distinguished at a distance by their red colour. On the neck, between these and Thrum Cap, which can be traversed only at low water, and even then by stepping stones and wading, are immense boulders of quartzite in great number. These unquestionably were carried by glacial action from Bedford Basin on the north. Among these is a large number of Archæan boulders from the Cobequid Mountains, at a distance of seventy-five miles. These consist of syenitic gneisses and diorites containing magnetite, sometimes in considerable quantity, as well as granites—some of which are hornblendic, porphyrites, etc. Associated with these are boulders of basalt, having magnetite and olivine, and numerous boulders of amygdaloid, having amygdules of stilbite, heulandite and chalcedony. These have been transported from Blomidon or Partridge Islands from distances of sixty-three and sixty-eight miles. Thrum Cap is wholly glacial drift, exposed in red sections, which are washed by the waves of the Atlantic. In these sections we collected, in the drift and *in situ*, boulders similar to those on the neck. My associate, Col. Akers, R.E., directed my attention to a large mass of quartzite lying at the foot of the section. This was grooved and scratched in a singular manner. I at once recognised it as part of the graving machine that had grooved and striated the rocks of the Halifax Peninsula. The striation of Point Pleasant extended seaward touches Thrum Cap. The drift of this small island was doubtless a continuation of that of McNab's Island. It was, in all probability, coterminous (seaward) with Thrum Cap shoal,—the storms of the Atlantic having been the denuding in both cases. Thrum Cap is of additional interest, as it is the advanced point of glacial agencies transportation in Eastern Canada and America.

IV.—*Illustrations of the Fauna of the St. John Group continued. No. III.—Descriptions of new Genera and Species, (including a description of a new Species of Solenopleura by J. F. Whiteaves.)* *By* GEO. F. MATTHEW, M.A.

(Presented May 26, 1885.)

The accumulation of material has made it necessary to change the plan of this memoir to some extent. It was begun chiefly with the object of exhibiting the variations observable in the trilobites of the above-named formation; but so many interesting forms belonging to other groups of the animal kingdom have been met with in the material examined, that the author thinks a description of these will be a useful preliminary to further study of the development and variation of form in the several species.

I.—PROTOZOA.

Several organisms of the group *Calcispongia* occur in the strata of Division 1, and of these the author here describes one which can easily be recognized by its external form.

ARCHEOCYATHUS, Billings.

Under this name Mr. Billings has described, from a limestone of Potsdam age in Labrador, certain sponges which, in the appearance of their outer and inner walls, and the intervening loculi, resemble the species the author is about to describe; but they differ from it in general form, and are much larger. It is proposed, however, to describe the species above referred to under this genus, pending a more extended and careful examination of the more ancient fossils of this kind.

ARCHEOCYATHUS ? PAVONOIDES, n. sp. (Plate V. Figs. 1*a*, *b*, *c* and *d*.)

General form that of a more or less flattened disk, with ascending and irregularly cylindrical branches; these branches are generally hollow, though sometimes filled with a cellular mass, traversed by irregular loculi. Next the outer wall of the cylindrical branches or tubes of the skeleton, the arrangement of the pores or openings is more regular; here may be recognized the inner surface of the wall, marked by transverse parallel projecting lines of growth, which encircle the alternately expanding and contracting, ascending branches; there are less distinct longitudinal lines or striæ, which connect and often traverse the surface of these engirdling ridges, giving the surface a cancellated appearance: the outer surface of the wall is marked by close-set pits or pores, and shows a faint longitudinal striation between the numerous pores with which the surface is studded. The outer and inner walls are frequently seen to be separated by

loculi, which have a longitudinal arrangement, and are connected by frequent transverse openings through the dividing septa. The ascending branches of the skeleton are not always cylindrical and tubular, but sometimes take the form of leaf-like plates.

Length of the ascending branches of the skeleton, 14 mm. or more. Engirdling striæ of same about $\frac{1}{4}$ to $\frac{1}{2}$ mm. apart; longitudinal striæ about 10 in the space of a millimetre.

Horizon and *Locality.* In greyish-grey shale of Div. 1.*c.* Hanford Brook, St. Martin's. Rare.

PROTOSPONGIA, Salter.

Among the more delicate organisms in the shales is one which appears to be congeneric with Protospongia, as represented by *P. major* (Hicks), of the Welsh Cambrian strata (Solva group). The writer has therefore placed it under Protozoa, although he thinks there are strong reasons for associating it with the Hydrozoa, and especially with Dictyonema, as the skeleton appears to be horny and there seem to be cellules on some of the ribs; if on further examination they prove to be of the nature of hydroids, he would suggest for them the name of *Protodictya.*

Protospongia (?) minor, n. sp. (Plate V. Fig. 2.)

A thin, flattened or lamellar frond, traversed by delicate ribs or fibres: these are usually in sets, nearly at right angles with each other, though sometimes apparently branching; at distant intervals there are solitary fibres or ribs, of greater thickness than those which form the principal part of the skeleton. The framework supporting this fossil appears to be of horny rather than siliceous consistency, and does not differ in its conditions from those of a fossil referred further on to the Hydrozoa.

Size and form unknown, but patches or films of the organism, an inch in diameter, have been met with, and it is sometimes found in overlapping layers that give a laminated structure to the shales in which it occurs. The spaces between the parallel fibres of the framework are about $\frac{1}{2}$ of a millimetre.

This organism, though of much smaller size, is very similar to *Protospongia major* (Hicks). It may also be compared with *Dictyonema irregularis* (Hall) of the Quebec group.

Horizon and *Locality.* In the fine-grey shales of Div. 1.*c*, at Porter's Brook, St. Martin's.

Protospongia (?) minor, *var.* distans. (Plate V. Fig. 3.)

This with meshes of twice the size of those above described, and with more distinct bars, occurs at a higher horizon.

Horizon and *Locality.* In the fine, dark shales of Div. 1.*d*, at Porter's Brook, St. Martin's.

EOCORYNE, n. gen.

In the fine shales of Division 1 are layers which have minute, hollow, branching, siliceous organisms, of a white colour, scattered over the surface; these objects are rigid and penetrate the layers of the shale; they appear to be excluded from the Radiolarians by

the absence of a radiate structure, and, so far as can be observed, by the absence of pores on the surface; they seem more like the spicules of sponges, many of which have a similar branched form, and hollow core, but their smoothness and great size may seem objections to this view. They differ from the Conodonts of Pander, as described by Owen, in not having "sharp opposite margins," but may be the teeth of some Mollusc or Annelid. Until their structure and affinities are better known, it seems best to place them here.

EOCORYNE GEMINUM, n. sp. (Plate V. Figs. 4*a* and *b*.)

These have two or four (rarely three) conical, ascending, pointed branches or cusps; there is no observed opening either at the base or points. The cusps are in pairs opposite to each other; the base of the organism is rounded, and the whole surface smooth, and no pores are made visible by an ordinary lens.

Length, $1\frac{1}{2}$ to 2 mm.

Horizon and *Locality*. In the fine shales of Div. 1.*c*, at Hanford Brook, and of Div. 1.*d*, at Porter's Brook, Saint Martin's.

II.—HYDROZOA.

DENDROGRAPSUS, Hall.

DENDROGRAPSUS (?) PRIMORDIALIS, n. sp. (Plate V. Figs. 5, 5*a* and *b*.)

The stem or foot-stalk has a branching root or base; it is irregularly striate along the sides, and tapers from the root upward.

The branches are slender, diverge at varying angles, and are usually dichotomously divided and subdivided; branchlets most frequent towards the extremities; cell markings most distinct on those parts of the branchlets which are least subdivided, the branchlets sometimes exhibit indications of a faint alation on each side.

The cellules appear as knots or undulations along the surface of the branchlet, usually somewhat further apart than its width, sometimes twice as far apart. The orifice appears as a transverse slit and is not directed upwards; the branchlet has the appearance of being constricted between the cellules.

This species appears to be allied to *D. Hallianus* (Prout), of the Potsdam sandstone, but it is smaller, and the branchlets diverge at a wider angle; the mouth of the cellule in our species does not have the ascending attitude of those of the species cited.

Size. The footstalk is about one millimetre wide, and many of the branchlets about one quarter of this width.

Horizon and *Locality*. In the fine dark shales of Div. 1.*d*, at Porter's Brook, St. Martin's. Infrequent.

PROTOGRAPSUS, n. gen.

Another form which is found in the fine shales of Division 1, has many of the general characters of the Grapolitidæ, but does not seem referable to any described genus: it is

peculiar in the alation which extends along the axis of the stipe, without apparently bearing cells at the margin; it combines characters found in *Retiolites* (Barrande) and others of the immature stipes of some species of *Dichograptus* (Salter.)

Stipes thin, flat, elongate, dichotomously branched; having a central axis, and being alate on each side; pores arranged along the axis of the stipe; axis and margin of the stipe connected by delicate nervures.

Protograpsus alatus, n. sp. (Plate V. Fig. 6.)

Root, or initial point, unknown.

Frond dichotomously branching at wide angles, and usually angulated at a short distance from the branches. The axis is subterete, and shows but little diminution in size after branching: an alation or thin membrane, borders the axis on each side throughout; faint, thread-like ascending nerves diverge from the axis, at somewhat distant intervals, and extend in the direction of the defined margin of the lateral membrane.

Cellules. Decorticated examples show the pores distributed along the axis at regular intervals; in some examples the pores are indicated by elliptical elevations along the axis, but none have been observed which present the transverse ridges observable in *Dendrograptus* (?) *primordialis.*

Numerous fragments of this organism have been found, and it is readily recognized by the alation of the stipe. In this respect it reminds one of the disc connecting the initial branches of species of *Tetragraptus* and *Dichograptus* (Salter); this alate condition, however, appears to be a permanent one in Protograpsus. Among the graptolites of the Quebec group, *G. crucifer*, *G. Headi* and *G. alatus* have the disk extended in the form of wings along the sides of the stipe; and in *G. Logani* (Geological Survey of Canada, Decade II, Pl. IX. Fig. 8) not only does the disk extend for some distance along the branches of the stipe, but there is an appearance of a double row of cells along the lower branches, similar to the minute nervures of the alation in Protograpsus. The nervures are arranged in a way similar to those of *Retiolites* of Barrande (Geol. Surv. Can., Dec. II, Pl. B. Figs. 20 and 21, and Pl. XIV. Figs. 3 and 4), but though there is a defined margin to the alation in Protograpsus, no cellules have been detected on the margins of the membrane.

Size. The length of the frond is unknown, but the width, including the alæ, is about 2 mm.

Horizon and *Locality.* In the fine dark shales of Div. 1.*d*, at Porter's Brook, St. Martin's.

III.—ECHINODERMATA.

EOCYSTITES, Billings.

Eocystites primævus, *Billings.*

Acadian Geology, 2nd. Ed. p. 643, Fig. 220. United States Geological Survey, Bulletin 10, p. 14, Pl. I. Fig. 2.

Various forms of cystidian plates are found in the measures of Div. 1.*c*, which serve

to give a better idea of the species above cited, than the descriptions in the works above referred to: one example appears to indicate that this species possessed a short stem upon which the basal plate was set, but the material in hand is still too imperfect to give a satisfactory view of the complete skeleton, and is reserved for future examination. The species has not yet been found to extend beyond the limits of Div. 1.*c*.

IV.—BRACHIOPODA.

LINGULELLA, Salter.

LINGULELLA (?) INFLATA, n. sp. (Plate V. Figs. 7 and 7a.)

Of this species only the ventral valve is known. This is broadly ovate, rounding rather abruptly to the front from about the middle of its length. The shell is strongly arched from the beak and sides toward the middle, the highest point being about one third from the beak. The beak is acutely triangular but not attenuated, and for some distance from it the diverging sides are nearly straight.

Sculpture. The surface of the shell is crossed by about seven slightly elevated lines or undulations concentric to the umbo; between these are numerous fine striæ of growth, scarcely visible to the naked eye.

This little shell is very high and round in the centre of the valve for a Lingula or Lingulella. It is about the size of *L. ferruginea* of the Welsh Cambrian, but differs in the triangular beak. It is smaller than *L. primæva* (Hicks) and also differs from that shell in being proportionately broader.

Length, 4 mm. *Width*, 3½ mm.

Horizon and *Locality.* In the dark sandstones of Div. 1.*b*, at Hanford Brook, St. Martin's.

LINGULELLA DAWSONI, n. sp. (Plate V. Figs. 9a, b, c, and d.)

Lingula ? Dawsoni, U. S. Geol. Survey, Bull. 10, Pl. V. Fig. 8.

A rather broad example of the ventral valve of this species was described in Mr. Walcott's bulletin as follows:—Shell small, broadly sub-elliptical, subattenuate toward the beak; margins gradually expanding and curving from the beak to the centre, where the shell has its greatest width, and thence narrowing toward the front, which is broadly rounded. General surface depressed convex, becoming more convex toward the beak.

Surface marked by fine, undulating, concentric lines, crossed by radiating lines that are seen only by the aid of a strong magnifying glass

In form this species approaches *Lingulella ferruginea* of Salter (Manual British Fossil Brachiopoda, Davidson, Vol. III. p. 336), of the Menevian formation of Wales quite closely; but, with only a specimen of the ventral valve to compare with it, it is difficult satisfactorily to determine its specific relations.

A series of individuals of this species enables the writer to give more fully the specific characters:—

The dorsal valve of the size figured in Mr. Walcott's bulletin is about as wide as it is

long; it is more inflated than the ventral valve, and differs from it in being decidedly arched from the beak to the front.

These characters, however, do not fully represent the species, which shows quite important variation in the adult forms. In the ventral valve, the beak is more attenuated in the mature shell and the front more squarely rounded, the extreme width of the shell at that age being about one third from the front, which is very gently curved.

The dorsal valve in the adult exhibits a corresponding change in outline, the widest part being nearer to the front than to the umbo. In both valves the shell slopes gently on both sides and in front, to the margin. The ventral valve is flatter than the dorsal, and not arched at the margin, between beak and front, like the latter.

Sculpture, as described in Mr. Walcott's bulletin. There are about eight or ten concentric striæ that are more distinct than the others; within these, near the umbo, is a thickened, glossy, elevated portion of the shell.

This species when half grown may be compared to *Lingulella ferruginea* of the Welsh Cambrian, but in its adult stage approaches somewhat to the form of a true Lingula; the following changes of form in the ventral valve of young, medium-sized and adult specimens has been observed:—At 2½ mm., length and breadth nearly equal; at 3½ mm., length one fifth greater than width; at 6 mm., length one half greater than width.

The author has dedicated this species to Sir William Dawson, who has done so much to make known the ancient fauna of St. John group by his publication in the "Acadian Geology" of the forms first observed in this formation.

Length, 6 mm. *Width*, 4½ mm.

Horizon and *Locality*. Found at Portland, N.B., at Ratcliff Stream, Simonds, and at Hanford Brook, St. Martin's, chiefly in the grey shales of Div. 1.*c*. The young or a dwarf variety has been observed in the dark grey shales of Div. 1.*d*, at Porter's Brook, St. Martin's.

LINGULELLA LINGULOIDES, n. sp. (Plate V. Figs. 8, 8*a* and *b*.)

Ovately elliptical, one half longer than wide.

Dorsal valve almost regularly elliptical, slightly produced at the umbo, which is moderately elevated; the more tumid part of the valve is wider than that of the ventral, and extends about half-way to the front.

Ventral valve subattenuate at the umbo, which is rather prominent; central half of the valve markedly elevated above the sides for nearly its whole length, and more tumid than the dorsal valve.

Sculpture. Surface marked by numerous sharp concentric striæ, of which about six or seven placed at regular intervals, are more distinct than the others. More faintly marked radiating striæ can also be traced on the surface of the shell, especially towards the margin.

This little species is about the size of *Lingulella ferruginea* (Salter), but it differs in its comparatively greater length, and in the elliptical outline of its valves. It differs from the Acadian species last described in its greater comparative length, in its tumid ventral valve, etc.

Length, 4 mm. *Width*, 2½ mm.

Locality and *Horizon*. In the fine dark shales of Div. 1.*d*, at Porter's Brook, St. Martin's. Rare.

The hinge area and foraminal grove of Lingulella are well displayed in the ventral valve of this species.

Another, radially ribbed species of *Lingulella* (?) occurs in the fine shale of Div. 1.*d;* but the material is too imperfect for description.

LINNARSSONIA, Walcott.

Mr. C. D. Walcott proposes this as a new genus to include *Obolella transversa* (Hartt), of the St. John group, and *O. sagittalis* (Salter), of the Welsh Cambrian. The St. John species, of which there are two, differ from the types of Obolella in the form of the muscular scars and in the substance of the shell, which is more or less phosphatic or horny. On account of the differences in the muscular impressions, etc., Mr. Walcott separates these shells under the above name. (See *American Journal of Science*, III, Vol. XXIX. No. 170, p. 115).

Linnarssonia transversa, *Hartt*, sp. (Plate V. Figs. 11, 11*a*, *b*, *c*, *d*, and *e*.)

Obolella transversa, Hartt. Acad. Geol., 2nd Ed., p. 644. U.S. Geol. Surv., Bull. 10, Pl. I. Figs. 5 and 5*a*.

This is one of the earliest species of the St. John group, since it is found as low down as the first layers of the group *b* in Div. 1. It ranges upward through *b*, *c*, and *d*, as far as the latter member has been explored. It has a thicker shell than the other smaller brachiopods associated with it, and is therefore less distorted than the other small species. The examples which exhibit most clearly the generic character of this species are found in the dark shales of 1.*d*. From these it may be seen that, in the form of the median furrows of the dorsal valve, it is quite distinct from *L. sagittalis* (Salter). There are differences of proportion in the internal characters of the ventral valves of the two species. This may be seen by reference to Mr. Walcott's Note, establishing the genus *Linnarssonia* (*Am. Jour. Sci.*, Feb., 1885.) The affinities of this genus to Acrotreta, especially to the forms in the Paradoxides beds, are apparent.

Linnarssonia misera, *Billings*, sp. (?) (Plate V. Figs. 12, 12*a*, *b*, *c*, *d* and *e*.)

Obolella (?) *misera*, Billings. Palæozoic Fossils, Vol. II. Part I. p. 69.

The fine shales of Div. 1.*d* contain numerous examples of a little shell which appears to be identical with this species. It occurs in the same measures as *L. transversa*. The writer gives the following characters to distinguish the two species :—

In *L. misera* the valves are flatter and the hinge line longer. The shell substance is thinner, and often does not exhibit so decidedly the black colour which marks the thicker valves of *L. transversa.*

The dorsal valve is somewhat lower at the umbo than the corresponding valve of that shell, and the internal median ridge is narrower, sharper, and less conspicuous; it extends across the umbonal hollow as a thin thread-like line; the muscular scars are smaller and closer to the umbo.

The ventral valve has a small hinge area, and a more faintly marked apical pit than

L. transversa; the apical, internal tubercle is smaller, the muscular scars at the hinge line are also smaller, and the ridges that diverge from behind the apical tubercle and extend toward the front of the shell are less conspicuous.

Sculpture. Outer surface of the shell smooth, with concentric undulations of growth; under the lens fine concentric striæ are visible, and a few faint radiating striæ.

The shell substance in this species is very thin; frequently only the part of the shell which contains the vital organs is black and shining from the presence of phosphatic matter. Notwithstanding the existence of a small hinge area in this species it is so near the type of *Linnarssonia* in other respects that it seems to find its place in that genus rather than in *Acrotreta.*

Through the kindness of Mr. J. F. Whiteaves, the author has been able to examine the type of *Obolella* (?) *misera*, of Billings, from the Cambrian rocks of Newfoundland. Only the dorsal valve of this species is preserved, and it agrees as to size, form, and surface markings with our species, but the internal characters are not exhibited. Mr. Billings describes the ventral valve as depressed conical, and in this respect his species would agree with the little shell now under consideration, which, owing to its false hinge area, has a somewhat conical valve. But not having seen the ventral valve of *O.* (?) *misera* or the internal markings of either valve of the Newfoundland shell, the author cannot be sure of its identity with the Acadian species.

Length, $2\frac{1}{2}$ mm. *Width*, 3 mm.

Horizon and *Locality.* In the fine dark shales of Div. 1.*d*, at Porter's Brook, St. Martin's, N.B.

ACROTRETA, Kutorga.

Acrotreta Baileyi, n. sp. (Plate V. Figs. 13, 13*a*, *b* and *c*.)

Transversely oval orbicular. Greatest width somewhat in front of the middle of the shell. The margin is nearly straight on the hinge line, which is less than half of the transverse diameter.

The dorsal valve is moderately convex, strongly arched upward from hinge to front, but less arched transversely. The interior of the valve has a short mesian ridge, slightly expanded at the extremity, which is more than half way from the hinge line to the front margin. From this ridge two others of less than half its length diverge, arching outward from near the hinge line. Two subtriangular muscular scars lie between these short ridges and the posterior margin of the valve, near the hinge line; two other fainter triangular muscular scars lie between the two diverging ridges and the mesian ridge.

The ventral valve is conical with a moderately elevated umbo, which is less than one third of the longitudinal diameter from the hinge line; the valve is thickened at the umbo, where a prominent boss or tubercle appears within the shell. The hinge area is triangular, has a sharp vertical groove in the middle, and is crossed by a few transverse striæ. The umbonal tubercle is the most prominent feature within the shell, and from its front several parallel striæ extend to the anterior margin; two minute muscular scars are visible in front of the tubercle, close to it, on each side of the parallel striæ. The interior of this valve (as preserved in the shale) has several concentric ridges, strongest at the anterior half of the valve.

Externally, the surface of both valves is marked by fine radiating striæ, which are crossed by more distinct concentric striæ. The surface of the ventral valve (as preserved in the shales) has also a number of concentric ridges.

The dorsal valve of this species is not unlike that of *Linnarssonia transversa*, but the two species are easily distinguished by their ventral valves, and they differ much in the thickness of the shells; in *Acrotreta Baileyi* the shell is very thin, so much so that in the dark sandstones, near the base of Division 1, where apparently it is first found, it can be recognized as an Acrotreta only by the peculiar form of the ventral valve. This species in its form is like *A. Nicholsoni* (Davidson), of the British Cambrian strata; it may be distinguished from that species by the internal markings of the dorsal valve. Our species is evidently quite distinct from *A. socialis* (Von Seebach), which has a much higher ventral valve, and has been found at several horizons in the Parodoxides beds of Sweden.

Length $3\frac{1}{2}$ mm. *Width*, 4 mm.

Horizon and *Locality*. In the dark, sandstones of Div. $1.b^2$, at Hanford Brook are distorted examples of an Acrotreta which may be this species. The species occurs at Long Reach, King's County, with *Ptychoparia Robbi* (?) in shales, the exact age of which has not been determined. At this locality it was collected by Professor L. W. Bailey.

ACROTRETA (?) GULIELMI, n. sp. (Plate V. Figs. 14, 14*a*, *b*, *c*, *d* and *e*.)

Shell substance corneous. Outline circular, or slightly wider than long.

The dorsal valve is saucer-shaped, being slightly convex, and having the margin involute. This valve has an outer zone of growth that is apparently thicker than the central part, as the latter is often only imperfectly preserved. The position of the umbo is somewhat obscure, but appears to be about one quarter or one fifth of the diameter of the valve, from its posterior side.

The interior of the dorsal valve, in the examples known, has an oval or circular scar, extending from a point about one fifth from the posterior side to the middle of the valve. Outside of the central scar, the surface is divided into four segments of unequal size by faint furrows extending to the margin. The two posterior furrows are nearly straight; the two anterior are longer and arch outward from the front of the central scar towards the lateral margins. The posterior segment is smaller than the others, and there the valve is deflected upward (as seen when looking down into the valve); within this segment of the valve there are two minute pits on the posterior edge of the central scar, and behind these are two minute (muscular?) tubercles; both pits and tubercles are close to the axial line, which is marked by a narrow, faintly-raised ridge, extending to the posterior margin of the valve. Each lateral segment of the valve has a narrow, faint ridge, which cuts off a slightly depressed, lunate portion on its anterior side. The anterior segment of the valve has a median furrow, proceeding from the front of the central scar, and forking about one third from the front of the valve; here it becomes faint, and encloses a shallow, oval depression; within the anterior segment of the valve there are also two short faint furrows, one on each side of the median furrow, extending outward from the central scar. The inner surface of the valve, on each side of the central scar, and in front of it, is covered with faint raised lines radiating to the margin, and similar radiations appear to be indicated along the posterior border of the valve.

The young individual figured differs from the adult, as shown by several full-grown shells, in having a wider marginal area and a narrower central scar; the little pits at the back of this scar are also fainter, and the (muscular ?) elevation behind has a larger surface, though less prominent in the young than in the adult. As compared with the young individual, the adult shell shows a condensation of the parts in the posterior segment of the valve, and a shortening of the space between the umbo and the posterior margin. The adult shell is also proportionately wider than that of the young.

Ventral valve depressed-conical. Umbo about one third from the posterior margin, terminating in a round foramen, which is encircled by a narrow elevated rim. The surface of the valve slopes rapidly from the umbo to the posterior margin, or is slightly concave, but in front of the umbo, the slope to the anterior margin is a little convex. The margin itself is reflexed all around, especially in the anterior and lateral part. In many examples of the shell there is no trace of an area, but the lines of growth appear to go regularly round the posterior slope; in a few, a faint furrow, sloping broadly on each side, to the posterior margin of the axial line breaks the uniformity of the encircling lines, and gives the appearance of a false area, but this appearance may be due to exfoliation of the shell, revealing an internal ridge. Usually there is no foraminal groove visible, but some examples of the ventral valve have a narrow, transversely striated depression, extending on the axial line from the umbo to the posterior margin.

The mould of the interior of a ventral valve of this species, rather than of any other known at this horizon in the St. John group, has, in front of the foramen, a large, rounded, ovate, median lobe, enclosed by a flattened, horseshoe-shaped area, extending to the margin of the valve on each side of the median lobe. The remaining (posterior) part of the valve has a muscular impression on each side of the axial line behind the foramen, from which, on each side of these scars, an obscurely defined ridge extends to the margin of the valve; the foraminal opening is encircled by a raised ridge from which a faint ridge extends along the axial line to the posterior margin, The flattened lateral slopes of the valve are bounded on the inner side by a furrow, which is faint along the posterior end of the slope, more clearly defined opposite the foramen, and suddenly deepens where it turns forward along the side of the median lobe: on each side of the valve, at the posterior end of the lateral slopes, two faint depressions arch forward across these slopes, from the foraminal side of the slope toward the lateral margin of the valve; a sigmoid row of minute pits, whose general course is paralled to the axial line of the valve extends from the posterior toward the anterior ends of the lateral slopes of the valve; a fainter row of minute pits arches round the anterior end of the median lobe. Both the lateral slopes and the median lobe are covered with diverging, forking, raised lines, which, on the back and middle of each of the lateral slopes, are transverse, but on the median lobe are directed forward: on the sides of the median lobe, these lines are nearly parallel to the furrow which bounds it, but on the middle and front diverge and fork in their extension toward the front of the valve.

Sculpture. The outer surface in both valves is covered with closely-placed concentric striæ, and there are more strongly marked concentric lines of growth, usually three or four, between the umbo and the margin. There, are also finer, radiating ridges, diverging from the summit of the valves to the margin; these with the lines of growth, often found crowded along the margin, give that part of the valves a cancellated appearance. There is a minute

sculpturing on the surface of the shell, visible only with a powerful lens, which is not a regular granulation, but an irregular roughing of the surface. All the markings are most distinct on the outer third of the valves.

This interesting little species is referred provisionally to *Acrotreta* as the nearest genus; but there seem to be radical differences (if the cast of a ventral valve above described is of this species) in the internal markings, and there are features which remind one both of *Discina* and *Orthis*. The species also has a general resemblance to *Acrothele coriacea* (Linnarsson) of the Swedish Cambrian rocks, especially in the dorsal valve.[1] This is the shell which was referred to by the author in Bulletin IV of the Natural History Society of New Brunswick, St. John, as a *Scenella*, but on investigation it proved to be a Brachiopod.

Length, $3\frac{1}{2}$ mm. *Width*, $3\frac{1}{2}$ mm.

Horizon and *Locality*. In the fine, grey shales of Div. 1.*c*, at Portland, N.B. Scarce. Found by W. D. Matthew.

ACROTHELE, Linnarsson.

ACROTHELE MATTHEWI, *Hartt*, sp. (Plate V. Figs. 15 and 15*a*.)

Lingula Matthewi, Hartt. Acad. Geol., 2nd Ed., p. 644, Fig. 221.

Acrothele Matthewi, Hartt, sp. U.S. Geol. Surv., Bull. 10, p. 15. Pl. I. Fig. 4, 4*a*.

Professor Hartt described the dorsal valve, the only part known to him, in the following terms:—"Circular in outline or very slightly wider than long, extremely flat, the convexity being scarcely noticeable; shell very thin; on each side a segment, such as would be cut off by a cord running from the umbo to the extremity of the transverse diameter, is slightly turned up on the margin.—Inside, a strong mesian ridge, rounded, and of moderate width, runs from the umbo to a point a little beyond the middle of the shell; at the umbo, this ridge bears a small nail-like process or swelling, and there are two minute and extremely short secondary ridges, originating from the head of the primary, and extending obliquely backwards. Inner surface marked with numerous indistinct and irregular concentric striæ; outer surface not visible."

Professor Hartt's example was a flattened shell; as the dorsal valve, when not distorted by pressure, is convex, being strongly arched from hinge to front.

The following additions may be made to his description of the species:—Width about one sixth greater than the length. Hinge line about one fifth of the length of the transverse diameter. Ventral valve elevated and subconical in the posterior half, flattened or with margin reflected in the anterior and lateral slopes.

The dorsal valve has the following internal features in addition to those mentioned by Professor Hartt. The median ridge is accentuated by a minute tubercle scarcely half way from the hinge line to the front, but extends beyond this point, becoming fainter, to within one quarter of the longitudinal diameter, from the front: the two diverging lateral ridges, which broaden the mesian ridge in its posterior part, extend opposite the minute

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[1] Compare the central scar and two minute pits in figure of that species, in Brachiopoda of Paradoxides beds of Sweden., pp. 22, 23. Pl. iv. Fig. 43 *b*.

tubercle on the mesian ridge, and also bear similar little tubercles near their ends; these tubercles on the mesian ridge and its secondaries are on the margin of a depressed sub-circular area of the interior of the shell near the umbo; the depressed area is traversed near the middle by two delicate diverging arched ridges, which are about as long as the lateral branches of the mesian ridge, and extend toward the lateral margins of the valve. Behind these ridges, a stronger and broadly rounded ridge, limiting on each side the depressed area at the umbo, extends more directly toward the lateral margins, and separates the flattened marginal part of the valve, described by Professor Hartt, from the more tumid part at the umbo. There is a slight oval swelling of the mesian ridge near the umbo, but scarcely comparable to a nail head; at this part of the mesian ridge there is a *T*-shaped branching of the ridge, which, in some examples, appears to be confluent with the hinge line, as in *Acrothele granulata*, as figured by Professor W. C. Brogger,[1] but in others is separated from it by two minute pits, just within the posterior border. These lateral branches give the head of the mesian ridge a cruciform appearance.

The ventral valve in this species rises into a somewhat sharply conical umbo, which is perforated behind the apex. There is a faint indication of a narrow area, included in a wide triangular space behind the umbo, which is strongly striate externally, parallel to the hinge line. The front slope of the valve is often marked in the anterior half by a few faint, radiating undulations, or broadly rounded plicæ, which increase by intercalation; these folds are much more distinct on the inner than on the outer surface of the valve. The foramen is about one sixth from the posterior side of the valve, and there is a shallow depression on the inner surface of the valve from the foramen to the posterior margin.

The interior of the ventral valve has the following features:—There are two pits in the umbonal hollow in front of and close to the foramen; they are deeper behind than before, and are divided by a narrow ridge; a comma-shaped groove on each side of the umbonal depression extends forward opposite to the foramen on each side from the hinge area; the grooves are separated from the deeper part of the umbonal hollow by narrow low ridges, and from their extremities fainter grooves of about the same length arch outward toward the lateral margins. Just within the posterior margin there are four minute pits, of which the two inner correspond to small tooth-like projections of the dorsal valve; the two outer ones are opposite the posterior ends of the comma-shaped grooves of the umbonal depression. The posterior margin of the ventral valve has a narrow raised rim for the reception of the dorsal valve.

The inner surface of the valves is not perfectly smooth; it is marked by concentric undulations of growth, and when viewed with a lens is seen to be diversified with numerous, minute, shallow depressions. The ventral valve also has irregular, concentric rows of minute pits or tubercles, especially near the margins, which are related to the radiating plicæ found on this valve.

Sculpture. The surface of the ventral valve in this species is marked by four or five concentric lines of growth on the outer and flatter part of the valve, and by finer and less distinct lines on the inner and more tumid part; similar lines are found on the dorsal valve. The whole surface of the valves is also marked with a minuter sculpturing; towards the outer part of the valve this finer ornamentation is most distinct, and may be

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[1] Om Paradoxides skifrene ved Krekling, Tab. iv. Fig. 11.

seen to consist of fine wavy striæ, which often present an obliquely reticulated appearance, or when viewed in the line of the concentric striæ appear to consist of granulations; in some examples, the granulated appearance is obscure and the valves are more regularly striate.

The substance of the shell in this species is phosphatic as in Lingulella and Linnarssonia, and the inner layers are smooth and separate easily, so that the outer and inner surfaces of the valves are less frequently exposed in breaking the matrix in which the shells are embedded than are these smooth intermediate layers. The outer layer of the shell, which is granulated and striated, appears to be prismatic.

VARIETIES.

Acrothele Matthewi is one of those variable species which, without the intermediate forms, might be divided into several; the above description applies to the type, but there are two distinct varieties having the following characters:—

Var. α. PRIMA. (Plate V. Figs. 16 and 16*a*).

Valves flat, one fifth wider than long; test thin, ventral valve concave in the middle, umbo at the posterior margin, granulations nearly uniform over the whole surface.

Var. β. LATA. (Plate V. Figs. 17 and 17*a*.)

Apex directed upward, one third wider than long, umbo of the ventral one fifth from the posterior margin, which is nearly straight in the middle half; flattened marginal part of the dorsal is crescentiform and narrower than in the type; outer surface of the valves not known.

MEASUREMENTS OF THE TYPE OF *ACROTHELE MATTHEWI* AND THE VARIETIES (IN MILLIMETRES.)

Locality and Horizon.	Ventral. Length.	Ventral. Width.	Ventral. Proportion of width to length.	Dorsal. Length.	Dorsal. Width.	Dorsal. Proportion of width to length.
Type.						
Hanford Brook, 1.c.	7	8		4½	5	
"	5½	6½				1.17
Portland, 1.c.	9	12		6½	8	
"	7½	9	1.15			
"	4	5				
Porter's Brook, 1.*d*.	6½	7				

Locality and Horizon.	Ventral. Length.	Ventral. Width.	Ventral. Proportion of width to length.	Dorsal. Length.	Dorsal. Width.	Dorsal. Proportion of width to length.
Var. *α. prima* Hanford Brook, 1.*b*.	5	6		6	7	
"	5	6	1.2	5½	7	
"	5	6		5	6	1.2
Var. *β. lata.*						
Hanford Brook, 1.*b*.	6½	9	1.35			
Portland, 1.*c*.	6½	8½		7	9	1.33
"				5	7	

Horizon. This species is first met with in the dark grey sandstone of 1.*b*, being among the earliest species which entered the St. John Basin; at this horizon the variety *prima* is common in association with *Linnarssonia transversa*, an Acrotreta, and *Lingulella inflata*; a more tumid Acrothele than the variety *prima* and which may be the typical form of *A. Matthewi*, is also present. In the upper band of 1.*b*, which is of a finer texture than the sandstones of the lower band, var. *lata* was first found; and in the conglomerate above it which forms the base of 1.*c*, a form occurs which cannot be distinguished from the type of this species, except that it is not so tumid at the umbo. Professor Hartt's shell was from the shales of 1.c^2, above the conglomerate band, and it is in these finer shales and in those of 1.*d* that the typical form of the species is most abundant; even here, however, (at least in 1.*c*) it occurs in company with a broad form resembling, and probably identical with, var. *lata*.

Mr. Walcott compares this species with *Acrothele subsidua*, White,[1] from the Cambrian of Utah. It is evidently closely allied to *A. granulata*, Linnarsson, of the Lower Cambrian of Sweden, but it may be distinguished from that species by its straighter hinge line and greater breadth posteriorly.

KUTORGINA, Billings.

Kutorgina Latourensis, n. sp. (Plate V. Figs. 18, 18*a*, *b*, and *c*.)

Valves narrowly semi-circular, broader than long, flat; umbones low; greatest thickness in the posterior third; hinge line shorter than the width of the shell.

Dorsal valve with a distinct median depression extending from the umbo to the front margin, and with low ridges diverging from the beak toward the lateral thirds of the front of the valve. Umbo not elevated above the hinge area, which is exceedingly narrow or absent. Hinge line with two sharp slightly projecting teeth near the umbo.

Ventral valve with a narrow median ridge extending two thirds of the length of the valve toward the front margin; also with a fainter ridge on each side diverging towards the lateral third of the border of the valve; umbo very low; hinge area perceptible but very narrow, longitudinally striated, and having a minute tooth on each side of the very narrow and small foraminal opening.

Surface ornamented with about forty or fifty fine, faint, radiating striæ; those of the middle fifth are close, continuous, and straight; a few on each side of these are more divergent, while those near the back of the shell are fainter, closer than the last, and moderately arched outward toward the lateral borders. The surface of the valves is also marked by very fine but distinct concentric striæ; and at somewhat regular intervals by about twelve more distinct lines of growth. The concentric striæ are usually as distinct as the radiating. Casts of the interior of the valves exhibit a smooth surface with some irregular, sinuous, radiating striæ.

This shell is rather rare, and is distinguished from the Orthides by its smooth surface. The half-grown shell is about as wide as long.

The surface ornamentation of this shell is not unlike that of *Kutorgina sculptilis* (Meek,

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[1] Exploration and Survey. West 100 Meridian. Vol. iv. Pl. i. p. 34.

sp.) of the Upper Cambrian (U. S. Geol. Surv., 6th Annual Report, 1872, p. 479), as figured by Mr. C. D. Walcott, in his "Palæontology of the Eureka District," but it is more transverse, is shorter in the hinge line, and is a much larger species. From *K. cingulata*, the type of the genus, it is readily distinguished by its surface markings as well as from var. *pusilla* (Linnarss.) which occurs in Sweden a little above the horizon of our species; the Scandinavian shell is much smaller, and is distinct by the ornamentation of its surface.

Length, 7 mm. *Width*, 11 mm. Length of hinge line, 8 mm.

Horizon and *Locality*. In the slaty shales of Div. 1.*c*, at Portland, N. B.

N.B.—The apparent flatness of the umbones in this species may in part be due to the conditions under which it is preserved. It has as yet been found only in the slaty beds at Portland, where pressure may have distorted it in this respect.

KUTORGINA (?) PTERINEOIDES, n. sp. (Plate V. Fig. 19.)

There is a small bivalve shell in the fine shales of Div. 1.*c*, which, if not a lamillibranch or phyllopod, would appear to be another species of this genus; but if so, the valve representing it, is somewhat distorted by pressure. It has the form of a wide Pecten or Pterinea, with an apparent ear on one side of the umbo, and lunule on the other. The umbo is central on the hinge line and slightly furrowed along the middle: the hinge area is long and rather wide, and is marked by two faint furrows that diverge from the point of the umbo to the outer margin of the hinge area; this part of the margin is revolute, and marked by two shallow pits opposite the umbo; a sharp furrow along the posterial side of the valve indents the hinge area.

The surface of this shell is nearly smooth, but two or three radiating striæ are faintly visible near the axial line, and there are numerous, but obscure, concentric striæ which are most clearly defined on the middle of the valve.

Length, 3 mm. *Width*, 5 mm.

Horizon and *Locality*. In the fine, dark-grey shales of Div. 1.*c*, at Hanford Brook, St. Martin's.

ORTHIS, Dalman.

ORTHIS BILLINGSI, Hartt.

Orthis Billingsi, Hartt, Acad. Geol. 2nd Ed., p. 644, Fig. 223.

Orthis Billingsi, Hartt, U. S. Geol. Surv., Bull. 10, p. 17, Plate I. Fig. 1, 1*b–d*.

This common species has been so fully described by Messrs. Hartt and Walcott, that it seems unnecessary at present to enter into any further description of it, except in so far as it may be necessary to contrast it with a small species hereafter described, that is accociated with it. It may be said, however, in this connection that the species *O. Billingsi*, shows considerable variation in form during its growth; at first it is as long as wide, and has a deep median sinus; at a later stage it is nearly twice as wide as it is long, and in the adult stage becomes once and a half as wide as it is long.

ORTHIS QUACOENSIS, n. sp. (Plate V. Figs. 20, 20*a*, *b* and *c*.)

A small species. Subquadrate to semi-elliptical in outline; broader than long, widest

near or at the hinge line, which is not produced; moderately convex, highest in the posterior third, flattened toward the front and sides. Umbones not prominent.

The dorsal valve rises rapidly from the hinge line and has but a narrow, flattened space at the angles. It is about one third as high as it is long. The hinge plate has a narrow area, which is striated lengthwise, and bears two tooth-like processes close to the umbo, the point of which is bent down to the hinge line.

The ventral valve is somewhat more elevated than the dorsal. Hinge area triangular, sloping backward to the umbo, and bearing fine striæ parallel to the hinge line. Umbo elevated above the hinge line to a height fully equal to one third of the length of the valve. Foramen large, truncate-pyramidal in outline.

Surface of the valves ornamented by about twenty rounded plicæ, radiating (in the ventral valve) from the edge of the hinge area, opposite the foramen, and not from the beak alone; those on the middle fifth of each valve are crowded together, those outside of these are more prominent, and are continuous from the umbo; those toward the hinge-line are faintly marked and widely separated. The radiating plicæ do not (or rarely) increase by bifurcation. Both valves bear numerous concentric striæ, and are also marked by a few distinct squamose lines of growth.

The mould or cast of the interior of the valves of this species, is nearly smooth, or is marked by faint radiating striæ; the margin of the mould, however, often exhibits a crenulated appearance corresponding to the plicæ of the outer surface. There is a wide, smooth median depression at the top of the mould of the dorsal valve, near the umbo.

This little species is well separated from *Orthis Billingsi* by many differences which become obvious on a comparison of the two species: by the smooth spot in front of the umbo of the dorsal valve, by the less numerous and straighter radiating plicæ, by the fulness of the valves toward the cardinal angles, by the smooth mould of the interior, etc.

Among the Orthides of the Welsh Cambrian strata, *O. Carausii* resembles this species, but it has a few more plicæ, a flatter dorsal valve, and a smaller foramen proportionately; it is also four times as large as the Acadian species. Of the Swedish species, *O. exporrecta* (Linnarsson) comes nearest our species, but differs in its larger size, flat dorsal valve, plicated mould, etc. All the Swedish species are from the upper part of the Paradoxidian zone, whereas the Acadian forms reach down to the oldest beds in which Paradoxides is known. The Orthides of Div. 1.*c* of the St. John group and *Kutorgina Latourensis* are remarkable for the crowding together of the plicæ or striæ on the median fifth of the valve, and in this remind us of the arrangement of the ribs on the surface of the valves of the genera, *Spirifer* and *Atrypa;* a flattened area is thus formed across the middle of the valve. This feature is less obvious in *O. Billingsi* than in the other two species.

Length of the valve in *O. Quacoensis*, 5 mm. *Width*, 8 mm.

Horizon and *Locality*. In the shales of Div. 1.*c*, at Portland and at Porter's Brook, St. Martin's. Scarce.

V.—PTEROPODA.

HYOLITHES, Eichwald.

The hyolithoid pteropods of the St. John group differ from the ordinary type of this genus in several respects, but chiefly in that all the species known are furnished with septa near the apex of the tube.

In the examination of these fossils the writer has had the assistance of Professor Alpheus Hyatt of Boston, who has given much attention to the structure of the Cephalopods, and is well qualified to judge of the relationship of the pteropods in question to that class of Molluscs. Notwithstanding the remarkable resemblance of some of these chambered fossils to the Cephalopods, Professor Hyatt is of the opinion that they are not of this class, but are true Pteropods. Since these fossils were submitted to Prof. Hyatt, others have been found which exhibit a narrow and more or less flexible tube attached to the point of the shell, an appendage which appears to be analogous to the embryonic or larval tube or prosiphon of the Cephalopods, as described by several authors. It has not been found on all the species.

Dorsal and Ventral Sides. All of the Hyolithoid species thus far discovered in the St. John group are chambered near the apex, but some have also a sheath divided by diaphragms on one side of the tube. These two types of structure and especially the latter are not always easily recognized, owing to the delicacy of the parts and the imperfect condition of preservation, but they so palpably suggest relationships with the Cephalopods, that it seems desirable to compare them with that order of molluscs. To do so it is necessary that we should arrive at an intelligent understanding of the position of the animal of Hyolithes and its allies, relative to the shell.

In looking into the views expressed by different naturalists upon this point, we find a considerable diversity of opinion. The late J. W. Salter, palæontologist of the Geological Survey of Great Britain, if one may judge from his written descriptions of the Cambrian and Silurian pteropods, held the view that the side which in most species terminates in the long arched lip of the aperture is the ventral side; and this also is the opinion of the late E. Billings, palæontologist of the Canadian Survey. There is something to countenance this view, if the thecoid shells be regarded as straight cones with sides of nearly equal length, as some of them are; for the shorter side, being more rigid and strong, is adapted to protect the vital parts of the animal. But if we regard the oblique position of the aperture, and the tendency to an arched form so frequently exhibited by the tube or sheath in this group of shells, we should be inclined to an opposite conclusion.

Barrande, whose opportunities for observation were very great, must have found a difficulty in arriving at a conclusion on this point, for he is quite non-committal[1] in his

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[1] M. Barrande, however, seems to incline to take the same view of the relation of these sides of the shell as that adopted by Mr. Salter, for he says (p. 67): "Nous nous bornons à faire remarquer, que, si on considère la conformation de la coquille des *Pterotheca* (Pl. 15), qui paraît en connexion très rapprochée avec celle de *Hyolithes*, on reconnaît, que la surface convexe correspond aux deux petites faces de la gaîne, et que la surface concave correspond à la grande face de celle-ci. Par conséquent, si la surface convexe de la coquille est regardée comme dorsale, le bord dorsal du mollusque serait appliqué contre les deux petites faces et le bord ventral contre la grande face de la gaîne. Par analogie, il en serait de même dans *Hyolithes*."

great work on the Pteropods of the Silurian System in Bohemia, and uses the term "grande face" for the longer side, and "petites faces" for the shorter side of the shell. His terms, however, are artificial, as they imply a three-sided shell; it is true that many species of Hyolithes have a rudely triangular form, but others are nearly cylindrical or conical, and the flattening of the sides, even in those that are triangular, is more decided in the enlarged part of the cone than toward the apex. The writer has refrained from using Barrande's terms for the sides of Hyolithes, notwithstanding their convenience, for the Hyolithoid shells have a decided bi-lateral symmetry, as Barrande himself has observed, and it is desirable that we should ascertain which is the dorsal and which the ventral side of these fossils. As a means of determining this point, we may compare them with other classes of the Mollusca.

Cephalopods. One rule for determining the ventral side of a mollusc, referred to by S. P. Woodward,[1] viz., "that the *under* or *ventral side* of the body is that on which the funnel is placed," is not without exception, for we have only to compare the animal of *Nautilus pompilius* with that of any genus of the Dibranchiate Cephalopods to see that the position of the funnel is not uniform. It is quite possible, however, that the position of this organ in the living Nautili is anomalous, for if Barrande's interpretation of the lobes of the orifice in Gomphoceras and Phragmoceras is correct, the normal position of the siphon in these fossil genera is posterior or ventral. However this may be, the convex side of the spiral in the coiled Cephalopods is generally recognized as the dorsal. If the Hyolithidæ be compared with such Cephalopods, the convex side of the spire in these slightly curved shells may also be regarded as the dorsal, for the following reasons:—

1. The striæ of growth advance on that side, and in most species it is the longer side.
2. The nucleus of the operculum is found next the opposite side.

This position of the operculum is parallelled with that of Ammonites, if, as is supposed, the fossil called *Aptychus* is the operculum of Ammonites.

Gasteropods. Whether the Cephalopods furnish a parallel to the operculum in Hyolithes or not, it is quite certain that many genera of Gasteropods do, and we shall find that the nucleus of the operculum lies next the columella or ventral side of these shells. As regards the form of the orifice, there is in the Gasteropods the same advance of the striæ on the dorsal side as may be observed in the shell-bearing Cephalopods and on the side which we take to be the dorsal side in Hyolithes and its allies. The comparison is more readily made with the holostomatous gasteropods, but if allowance be made for the often excessive distortion of the aperture in the carnivorous genera and the carrion-feeders, the same advanced lip on the dorsal side may be observed in these.

In the Atlantidæ among the Heteropods as well as in Ianthina, etc., the tentacles and eyes are dorsal and anterior, and the operculum posterior as in other Gasteropods.

Pteropods. The pteropods, a class to which the Hyolithoid shells have been thought to have the nearest affinities, exhibit the same position of the dorsal and ventral sides relative to the aperture, as is found in the Dibranchiate Cephalopods and the Gasteropods. The extension of the dorsal side is very marked in some of the Hyaleidæ, and is observable in the genera which approach the Hyolithoid shells most nearly in form, such as Cleodora, Balantium and Creseis.

[1] See Manual of the Mollusca, by S. P. Woodward, p. 156, footnote.

Finding that the three classes of univalve molluscs agree as to the sides of the shell, which may be regarded as dorsal and ventral, we may well infer that the Hyolithoid forms, which exhibit affinities to the three, are likely to be in harmony with them in the matter of the dorsal and ventral sides.

Habitat. Whatever may have been the sphere of existence of the later species of Hyolithes there is no doubt that the early Cambrian forms of this type lived under conditions quite at variance with the habitat and mode of life of the modern Pteropods. It is obvious that all the thecoid shells of the St. John group belong to one class of molluscs, but of these shells some at least had strictly littoral habits. This was more especially the case with those of the genus *Diplotheca* (described below.) It is in this genus that we find the internal skeleton most complicated in its structure, and at the same time firmest to resist pressure from without. The shells of this genus were among the first of the encephalous mollusca to invade the St. John Basin; for they are found buried in the sand casts which fill the worm burrows, that are so common in certain parts of the sandstones of Division 1.*b*; they are also to be found in the phosphatic nodules which are scattered over the surfaces of this sandstone, and solitary shells are found sparsely spread on the sandy, ripple-marked layers of this rock. Fossils of this same genus are also to be met with in the conglomerate at the base of Division 1.*c*, either buried in its sandy calcareous paste or wedged between the small fragments of slate, which in company with phosphatic nodules form the coarser part of this rock.

It is true that the shells of Diplotheca are found, and indeed more plentifully in the overlying shales, where they occur in company with those of Camerotheca; but in these upper measures they do not present us with the same thick, horny shells, which characterize the individuals imbedded in the sandstones and conglomerates below. In other respects, however (except in the apical appendage of one species), they do not appear to differ in organization from the shells of this genus which are found in the coarser beds in the lower part of Division 1.

From the positions in which the shells of Diplotheca, as above described, are found, we cannot but believe that the animals which inhabited them were shore-dwellers, and therefore far removed in organization from the modern Pteropods. We find these described by various authors as inhabitants of the open ocean, and as approaching the shores only when driven thither by storms or currents. Another important feature in this class of animals is the fin-like organs of locomotion from which they take their name, and the absence of organs for climbing and to a great extent for prehension. We can hardly conceive of the Diplothecæ—living, as they did, in the sands of the sea-shore, or in the shallow, sheltered bays,—as being in any respect similar in their mode of life to the Pteropods: they appear to have occupied a place in the economy of Nature which was subsequently taken by the Gasteropods and Cephalopods, and, perhaps, the Lamellibranchs, and there is every probability that in many respects they were constituted like the two former classes, to both of which they present strong points of analogy. It is convenient, however, to retain them under the head of Pteropods, to which in their general form and structure they appear to have near affinities.

Subgenus.—*CAMEROTHECA*, n. subgen.

In describing these Hyolithoid shells of the St. John group, the simply camerated forms may be arranged under the above name.

General form that of a slender oval, or transversely oval, cone, with attenuated apex. In the smaller part of the tube or cone there are several septa that divide off segments of the tube from the body cavity (chamber of habitation). In most species this septate portion of the cone is prolonged toward the apex into a narrow, attenuated tubule, formed during the earliest stage of growth: the tubule is divided by transverse diaphragms (?) at regular intervals and is more or less flexible.

In these shells there is added to the ordinary body-cavity of the inseptate Hyolithes, two spaces or regions, showing antecedent conditions of growth, differing from that of the ordinary thecoid pteropod without septa. The first may be regarded as the *larval region*, and is perhaps most instructively exhibited in a shell belonging to the genus *Diplotheca*, described further on.[1] The tubule in this species is in the form of a flexible whip or tail, and as preserved in the shale, is not unfrequently twisted from the plane, in which the principal part of the shell is flattened, usually toward the ventral side, but sometimes to the right or left. In some cases this larval region is preserved in the shale as a flattened cylinder, in others as a very slender tubule, slowly expanding from the tip, but in all cases it is crossed by distinct annulations, about as far apart as the tube is wide, and of a firmer texture than the interspaces. Whether the prominence of these nodes is due to the thickening of the tube, or to the transverse diaphragms within, does not clearly appear, but the latter alternative seems the more probable one.

The mucronate point, in which the apex of most of the species of Hyolithes terminates, may be seen to have been formed in the upper part of this tube in some specimens of *Diplotheca caudata*, but others do not show it. This mucronate point at the top of the tubule in this species is the first thickening (or, in some cases, calcification ?) of the shell, and is the known apex of most species of Hyolithes; the absence of the tubule in later species is perhaps to be explained by its being deciduous or becoming absorbed at an earlier stage of growth.

The possession of a septate region is perhaps the feature by which this subgenus of pteropods can most easily be recognized, or at least separated from the commoner inseptate forms of Hyolithes. This portion of the shell is marked by a more rapid expansion of the cone, by added firmness of texture in the shell, and in some cases by its more decided thickening. The chambers, resulting from these septa near the apex of the shell, are not known to be connected by a siphon. This part of the shell, as preserved in the shale, is always more terete than the rest, and the walls of the cone above it, which enclose the body-cavity, expand less rapidly than those of the septate portion.

M. Joachim Barrande, in the third volume of his "Silurian System of Bohemia," mentions several species of Hyolithes that possessed chambers near the apex of the shell, but he makes no reference to the attenuated tube such as is found at the apex of some of the Acadian species. In the forms which he figures, the septa are closer together (in most of them much closer) and more numerous than those of the theciform shells of the Acadian

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[1] *Diplotheca Hyattiana*, var. *caudata*.

Paradoxides beds, and none of them occur as low down as the Olenus beds; hence it may be that the special forms hereinafter described are peculiar to the primordial fauna.

The modern genus, *Cuvieria*, possesses a septate shell, which has some features in common with Camerotheca, but the lower part of the body-cavity is more ventricose, and the lower chambers formed by the septa at the apex (if such ever existed) are broken off or from other cause, are wanting.

In order to make more complete the description of these pteropods, I introduce, from Bulletin No. 10 of the United States Geological Survey, the account of these species, reversing the use of the terms dorsal and ventral.

HYOLITHES (CAMEROTHECA) DANIANUS. (Plate VI. Figs. 1, 1*a*, *b* and *c*.)

Hyolithes Danianus, U.S. Geol. Surv., Bull. 10, p. 20, Pl. II. Fig. 7, 7*a* and *b*.

The form is that of an extremely elongate, rounded, subtriangular pyramid, that, in some examples curves a little to one side as it becomes gradually attenuate toward the apex. Transverse section semi-elliptical, moderately convex on the dorsal side, and still more on the ventral. Dorsal face flattened and almost concave along the centre, rounding upon each side to the somewhat rounder lateral angles. Ventral face not very strongly convex transversely. Form of aperture unknown.

An associated operculum is broad-oval, or subcircular in general form. The side corresponding to the dorsal side of the shell curves regularly, but is not as convex as the opposite side. The umbo (or nucleus) is situated about four fifths of the distance from the ventral margin, and from it two low rounded ridges extend laterally toward the rounded angles formed by the junction of the ventral and dorsal edges of the operculum. Just in front of these ridges a slight depression exists, also a depressed area back of the umbo, or towards the ventral margin; the inner side shows also a sharp, short, elevated ridge between the dorsal margin and the position of the umbo on the outer surface. The general body of the shell of the operculum appears to be quite thin.

Surface of the shell marked by transverse, concentric undulations of growth that arch slightly forward on the dorsal side. Outer surface of the operculum marked by fine, concentric striæ, and very fine, somewhat obscure, radiating striæ: inner surface with fine, slightly irregular, radiating lines or striæ. This operculum was not found in the mouth of the shell.

There is a considerable range of variation in the form of the shell of this species. In some the flattening of the dorsal side is lost, and only a convex surface is shown, and the ventral surface has a narrow, longitudinal line on each side of the centre. The curvature of the shell also varies considerably. A number of specimens of the operculum are associated with the shells, but none were observed in place, before the mouth of the shell.

Mr. Walcott says of the Hartt collection "that one unusually curved shell, having a nearly round section, was labelled *Orthoceras*, n. sp., by Professor Hartt, as traces of what appear to be septa are shown. The distances between the septa-like partitions are unequal, and in other specimens this is seen to be owing to the filling of cracks across the tube.—This species recalls *Hyolithes cinctus*, Barrande. Syst. Sil. Bohême, Vol. III. Plate IX, Figs. 8–12.—Formation and Locality. Cambrian, St. John formation, Ratcliff's Millstream, N.B."

Additional material from the St. John group enables the writer to add the following to the characters of this species, given in the Bulletin above cited:—

The shell was considerably attenuated toward the apex, and was septate in the apical third; some individuals had campanulate apertures. The dorsal face is usually convex, and has a well-rounded, elliptical margin at the aperture. The cast of an operculum found in the shale with this species has a deep crescent-shaped furrow behind the nucleus, and two linear furrows in front of the nucleus, diverging at an angle of about 130°.

The sculpture of the surface helps to distinguish this species from the others. The ventral side is marked by distinct but rather fine, transverse striæ; there are no lines of growth spaced at regular intervals, except toward the attenuated apex and the smaller camerated part of the shell; the sides of the ventral surface are striated with several interrupted, longitudinal lines. Most individuals show a decided arching forward on the dorsal surface of the faint undulatory lines of growth.

Length, about 30 mm. *Width*, about 7 mm. The rate of tapering in this shell is about 1 in 5, for the adult, and about 1 in 3½ for the young.

Horizon and *Locality*. In the fine, dark shales of 1.*c* and 1.*d*, at Porter's Brook, St. Martin's, and in 1.*c*, at Ratcliff's stream, Simonds, St. John Co., N.B.

HYOLITHES (CAMEROTHECA) GRACILIS, n. sp. (Plate VI. Figs. 2, 2*a*. and *b*.)

If certain slender apical portions of shells, found in the fine shales of 1.*d*, belong to this species, the form was that of an extremely elongated and transversely suboval cone, attenuated toward the apex, and almost cylindrical toward the aperture. The shell was septate in the apical third, and its walls were very thin.

The dorsal surface was flattened and terminated at the aperture, in a moderately-arched lip. The ventral surface was also somewhat flattened, and terminated in a slightly arched margin.

An operculum, differing from that of the preceding species, has been found in the layers of the shale with this species, which presents the following characters: it is thin and transversely oval, with a flatter curve on the ventral than on the dorsal side, and it is about one half wider than long; the nucleus is very close to the ventral side, and a well-marked depression extends on each side from the nucleus to the lateral angles; the space in front of the nucleus is slightly and broadly elevated, and has no angular slopes. The ventral slope of the operculum is abruptly turned up, and the nucleus is broad but not prominent. The surface of the operculum is marked on the inside by several engirdling lines of growth, and very faint, radiating striæ are discernible on some parts of the surface.

From three to six somewhat distant septa may be counted in the narrow part of the tube of this species; they are sometimes very distinct, but are often to be seen only as faint, transverse ridges across the flattened surface of the shell.

Sculpture. The ventral surface of this species presents, at the smaller end of the tube, distinct annulations of growth, regularly spaced, and rather close together; in some shells this surface appears otherwise to be smooth, but in others a strong lens brings to view very fine transverse striæ. The dorsal surface exhibits faint, arched striæ and undulations of growth.

The surface-markings of one side of the shell of this species, as preserved in the shales,

are apt to be impressed upon the other, owing to the thinness of the shell substance. The change in the form of this species during growth was considerable: at first the enlargement was at a very slow rate; subsequently, in the region where the most distinct septa are found, the tube expanded more rapidly, and finally, in the upper half the shell, became almost cylindrical, the rates of divergence of the sides being about one millimetre in a length of eleven.

Length, from the aperture to the oldest distinct septum, 23 mm., but including the apical portion (detached) 35 mm. *Width*, 6 mm. Rate of tapering in the adult (as flattened in the shale) about 1 to 9 for the wider two thirds of the shell, and 1 to 3½ for the apical third; the tapering of the young shell was about 1 in 6 mm.

Horizon and *Locality*. In the fine dark shales of 1.*d*, at Porter's Brook, St. Martin's, Frequent.

HYOLITHES (CAMEROTHECA) MICMAC. (Plate VI. Figs. 3 and 3*a*.)

Hyolithes Micmac, U. S. Geol. Surv., Bull. 10.

The original description of this species is as follows:—"Form, that of an extremely elongate, rounded, subtriangular pyramid, that becomes gradually attenuated toward the apex. The true transverse section is not preserved, owing to the crushing down of the shell, and appears to have been semi-elliptical or rounded subtriangular.—Form of aperture and operculum, unknown.—Surface of the shell, smooth, externally; the interior, marked by fine, raised, longitudinal lines.—In form this species is not unlike *Hyolithes* (*Camerotheca*) *Danianus*, but the smooth outer surface and striated inner surface distinguish it from that and also from any other described species known to me.—Dimensions: Length of specimen, 20 mm.; width at aperture, 4 mm.—Formation and Locality. Cambrian, St. John formation, associated with *Microdiscus punctatus*, var. *pulchellus* at Ratcliff's Millstream, N.B."

New material enables me to add to the description of this species. The form of the aperture differed from that of all the other species known in the St. John group, in that the dorsal side was but slightly arched upward at the lip; the aperture of the shell was somewhat campanulate, the ventral side being enlarged (as in *Hyolithes cinctus* and *H. parens*, Barr.)

The surface of the shell, though appearing to be smooth when viewed from the side, when viewed from the end with a lens, is seen to be crossed by numerous, fine striæ, and by sharp though low ridges, which are at nearly equal distances apart. With the aid of a strong lens also, very fine and close longitudinal striæ may be detected on the outer surface.

A few individuals have been found which have traces of septa near the apex, and Mr. C. D. Walcott informs me that specimens in the Hartt collection also show this feature. The shell of this species, like that of *C. gracilis*, is thin, and the narrow part is sometimes found bent to the right or left.

Length, about 15 mm. (one in the Hartt collection figured by Mr. Walcott is 22 mm.) *Width*, 3½ mm. Rate of tapering about 1 to 5.

Horizon and *Locality*. In the fine dark grey shales of 1.c^2, at Hanford Brook, St. Martin's; at Ratcliff's Stream, in Simond's, and in 1.c^2 at Portland.

DIPLOTHECA, n. gen.

Under this name the second genus of the Hyalithoid pteropods of the St. John group may be described.

Slender oval cones, somewhat triangular in section, with abbreviated or attenuated apices. In the narrower part of the tube or cone, there are several septa that divide off segments of the tube from the body cavity (chamber of habitation). The body cavity is separated from the ventral side by a thin partition supported by delicate transverse septa or diaphragms. The apex in one species is prolonged into a narrow attenuated flexible tubule with transverse annulations (diaphragms ?) at regular intervals.

This genus differs from the last in the more rapid enlargement of the shell during growth, and in having a firmer and (as preserved in the shales) rounder ventral side; the projecting ventral side is supposed to have been sustained by the lateral skeleton described above. The skeletal feature is most distinct in the thick-shelled varieties of two species which are found in the sandstones of 1.*b*. In these it has been observed on both edges of the ventral side, but has not been traced all the way around that side. Other varieties of these species from the fine shales of the overlying measures do not exhibit this feature with such distinctness.

The species of this genus thus far met with in the St. John group are peculiar in having the margin of the operculum angulated or notched at the meeting of the ventral and lateral slopes.

We find the following phases of growth in Hyolithes and its allies :—

Primary annulated tube, probably divided by diaphragms	*Diplotheca* and *Camerotheca*.
Simple conical tube	*Hyolithes* in part.
Conical tube, septate near the apex	*Hyolithes* in part, also *Camerotheca* and *Diplotheca*.
Conical tube with phragmate chamber at the side of the body cavity	*Diplotheca*.

The different phases of growth through which these pteropods passed suggest some interesting comparisons with the Cephalopods. Professor Alpheus Hyatt, in his article on the fossil Cephalopods, read at the Minneapolis Meeting of the American Association, 1883, concludes from his study of this group of animals that "the prototype of the Mollusca must have had a globose embryo attached to the apex, the apex composed of a living chamber opening into the protoconch or globose shell of the embryo without septa, though possibly divided more or less by diaphragms. Diaphragms precede the formation of the septa in the embryo Ammonoid," and "the prototype of the subclasses, *Tetrabranchiata* and *Dibranchiata*, must have been a form of the same type, with, however, a single septum or series of septa having closed cœca in place of a siphon." In these words there is almost an exact description of the larval and septate regions of the shells of Camerotheca and Diplotheca; and again there is a curious parallelism between the last phase of Diplotheca and the cephalopodous genera, *Phragmoceras*, *Ascoceras* and *Glossoceras*.

DIPLOTHECA HYATTIANA, n. sp. (Plate VI. Figs. 4 and 4*a*.)

Form that of a somewhat elongated cone, flattened on the dorsal side, and near the apex curved toward the ventral side; the arched part is divided by three or more trans-

verse septa, and the straight part is doubled on the ventral side by a delicate partition connected with the ventral side by very thin somewhat distant septa or diaphragms. The dorsal side terminates at the aperture in an elliptical lip, and appears to be smooth, except near the aperture and apex, where a few distant, faint striæ are found. The ventral side is rounded, but is not well exhibited in the examples known.

The operculum of the type of this species is not known.

The internal structure of this shell is shown by an example in a dark phosphatic nodule from the sandstones of $1.b^3$. In this the inside of the body cavity is filled with a grey deposit of a lighter color than the mass of the nodule ; a narrow band along the side. wall of the cavity is filled with a deposit of still lighter color, which may be seen to be separated from the deposit in the body cavity by a faint dark line, marking the place of the inner partition of the shell ; there are also faint transverse lines at intervals along this band, which are fragments of transverse diaphragms. The septa in the lower or camerated portion of the tube, below the body cavity, are thicker than those at the side of it, and go entirely across the shell.

Cyrtotheca hamula, Hicks, of the British Menevian fauna, may be congeneric with this shell. It possesses a similar curved apex.

Length, 7 mm. *Width*, $1\frac{1}{3}$ mm. Rate of tapering, 1 to 5.

Locality and *Horizon*. Infrequent in $1.b^3$ at Hanford Brook, St. Martin's, and this or a similar species is occasionally found in $1.c^2$ at the same locality.

DIPLOTHECA HYATTIANA, *var. α.* CAUDATA, n. var. (Plate VI. Figs. 5 and *5a*.)

This is a very marked variety, and may be a distinct species. Form that of an elongated cone, which, as preserved in the shales, is flattened on the dorsal side. The shell tapers uniformly to the apex, which is subulate; in numerous examples the point is attenuated into a flexible cauda or tubule crossed at intervals by raised annulations. The dorsal side of this variety is thin and smooth, and terminates in a semi-circular lip at the aperture. The ventral side is more strongly arched, and has a raised central band which is preserved in the shale as a smooth rounded rib, about one third of the width of this face of the shell.

The operculum is about as wide as long, and has an elevated marginal ridge, low and rounded, extending around the dorsal and lateral sides. The ventral slope is convex, and has two sharply-cut grooves on each side, radiating toward the margin. The lateral slopes are depressed, strongly defined at the front and outer margins, and have several faint, slightly-arched radiating striæ. The dorsal slope is convex, raised above the rest of the operculum, and has concave side margins, the surface is smooth, or with a faint median line. The cast apparently of this operculum has a pair of grooves, wide and deep at their their extremities, extending on each side of the nucleus, along the back of the lateral slope until they meet the projecting extremities of the marginal ridge.

Sculpture. The shell of this variety has a shining surface, especially when viewed lengthwise ; a lens of high power resolves the very fine striæ which cross the shell transversely, arching up over the dorsal face ; the ridges due to periodical cessation of growth, seen on other species, are not visible on this variety. There are two or three straight longitudinal striæ, nearly parallel to the sides of the shell, visible on each side of the ven-

tral face; and the side slopes of the operculum exhibit a few faint, distant, radiating striæ.

Length, (exclusive of the larval tubule), 8 to 10 mm; tubule, $1\frac{1}{2}$ to 2 mm. *Width*, as preserved in the shales, 2 to $2\frac{1}{2}$ mm.

Horizon and *Locality*. In the fine dark grey shales of Div. 1.*d*, at Porter's Brook, St. Martin's.

DIPLOTHECA ACADICA, *Hartt*, sp. (Plate VI. Figs. 6 and 6*a*.)

Hyolithes Acadicus, Hartt, sp. U. S. Geol. Surv., Bull. 10.

Theca Acadica, Hartt, mss. See the same Bulletin.

Mr. Walcott's description (reversing the terms "dorsal" and "ventral") is as follows:—

"Form, an elongate triangular pyramid, tapering gradually and uniformly to an acute extremity. Transverse section subtriangular, about twice as wide as high; the lateral angles acute from compression in the specimens in the collection. Dorsal face slightly arched; anterior margin extending forward in a semi-circular subspatulate extension. Ventral surface rather strongly convex. Aperture unknown, but undoubtedly oblique, judging from the character of the extension of the dorsal side.—Operculum unknown.—Surface of the shell marked by concentric lines of growth parallel to the margin of the aperture, and exceedingly fine longitudinal striæ, visible only by the aid of a strong magnifier.—In general form this species approaches very closely to *Hyolithes Americanus*, Bill. (Can. Nat. N. S., 1872. Vol. VI. p. 215), but equally so the Devonian *H. aclis*, Hall, (Pal. N. Y., Vol. V. Part 2, p. 197) except in the more rounded ventral side.—Owing to the imperfect condition of preservation of the species illustrated from the Menevian group of Wales, it is difficult to make comparisons with them. Professor Hartt's specific name is retained, as the probabilites are that the form is different from the American Potsdam and Georgian species, although allied to *H. primordialis*, Hall, (16th Ann. Rep. State Cab. Nat. Hist., page 135, 1863), and also the Menevian forms of the genus in Wales."

Formation and *Locality*. Cambrian, St. John formation, Ratcliff's Mill Stream, N.B.

This species is the most abundant of the larger Hyolithoid shells occurring in the lower part of the St. John group, and I may add the following to Mr. Walcott's description of the typical form:—

The form of the operculum associated with this species seems to indicate that the ventral side was regularly rounded and the dorsal somewhat flattened. The dorsal surface is often impressed near the edge of the shell by the longitudinal furrow corresponding to the margin of the phragmated sheath of the ventral side. One or two *V*-shaped seams also mark the surface of the body cavity near the inner end, and probably indicate the edges of the last two septa; in some examples a narrow band with transverse striæ, along the axial line, simulates a siphon.

An operculum which is common in the shales containing this species has the following characters: nucleus about one sixth of the diameter from the ventral side; depressed, owing to the strong upward flexure of the ventral slope. The ventral slope has about six radiating grooves or striæ on each side; the striæ do not quite reach the margin, and are arched slightly toward the extremities of the ventral slope. The side slopes are marked by about four straight radiating striæ, between which other lighter striæ are sometimes intercalated. The dorsal slope is large, flat, about as long as wide, and marked near the

nucleus by about a dozen straight radiating striæ; these striæ extend only one third from the nucleus, but a few near the sides of the slope may, in some examples, be traced to the margin of the operculum. The margin of the operculum is angulated at the junction of the ventral and lateral slopes. The whole surface of the operculum is marked by numerous, fine, concentric striæ, with a few stronger lines of growth at intervals.

The ventral surface of the shell of this species is marked by very fine, close-set, transverse striæ, varied by strong lines of growth at short intervals; in some examples raised transverse bands are found at intervals corresponding in distance to the diaphragms of the lateral skeleton. The inner side of the dorsal surface is smooth and silky looking, with faint undulations of growth, but under the lens is seen to have very delicate and rather distant, longitudinal, and also similar, arched, transverse striæ.

Among the Bohemian species we seem to have in *H. maximus*, Barr., (Pl. 12, Figs. 22-27 Syst. Sil. Bohém., Vol. III.) on a large scale, a type similar to this species; the compressed example figured presents a similar lateral furrow, but the operculum is not notched on the margin. The operculum found with our species may be compared with one of the "Second Fauna" from Bohemia, figured by M. Barrande (Plate 13, Fig. C, Syst. Silur. Bohém., Vol. III.) This operculum and those of A and B of the same plate have the peculiar lateral notch found in the opercula associated with the shells of Diplotheca.

Length, about 25 mm. *Width*, about 9 mm. Rate of tapering, 1 in $2\frac{1}{3}$ mm.

Locality and *Horizon*. In the fine dark shales of Div. 1.*d*, at Porter's Brook, St. Martin's Common.

DIPLOTHECA ACADICA, *var. α.* SERICEA. (Plate VI. Figs. 7, 7*a* and *b*.)

Differs from the type in the following particulars:—The shell is larger and more slender, and is attenuated toward the apex; the annulations or diaphragms at the apex are closely set.

The operculum found with this variety is longer than broad; the notch at the side is well marked, but the striæ on the dorsal slope are short and faint; the nucleus is four fifths of the diameter of the operculum from the front (dorsal) side.

Length of shell, 38 mm. *Breadth*, 13 mm. Rate of tapering, 1 in $2\frac{1}{2}$ mm.

Locality and *Horizon*, same as the type.

Var. β. OBTUSA. (Plate VI. Fig. 8.)

Differs from the type in the following particulars:—It is shorter and more obtuse toward the apex; there is a distinctly defined median ridge on the ventral side (like that of *D. caudata*.) One or more distinctly marked septa at the bottom of the body cavity. Lines of growth more distinct both on the dorsal and ventral side than on the type.

Operculum unknown.

Length, 30 mm. *Width*, 12 mm. Rate of tapering, 1 in 2 mm.

Locality and *Horizon*. In the fine grey shales of Div. 1.*c*, at Hanford Brook, St. Martin's. Not rare.

Var. γ. CRASSA. (Plate VI. Fig. 9.)

Differs from the type in having the shell shorter and more ventricose at the body

cavity. There are two or more septa near the apex, and about ten diaphragms in the lateral sheath beside the body cavity; these diaphragms are directly transverse on the ventral side, but bend toward the apex at their extremities on the dorsal side.

Striæ on the dorsal side coarser than in the type and strongly arched. Substance of the shell thicker than in the type.

Operculum unknown.

Length, about 33 mm. *Width*, 11 mm. Rate of tapering in the apical half, 1 in $1\frac{1}{2}$ mm.; in the wider half, 1 in 5 mm. Average tapering of the whole shell, 1 in $2\frac{1}{3}$ mm.

Locality and *Horizon*. In the purple-streaked sandstones of Div. $1.b^2$. Hanford Brook, St. Martin's. Frequent.

VI.—GASTEROPODA.

STENOTHECA, Hicks.

This genus was proposed by Dr. Henry Hicks in 1872 to include a minute corrugated shell found in the Menevian group in Wales. It was described by Dr. Hicks as a "curved shell," "a small wide form with lines of growth strongly marked on its surface." The genus is represented in Div. 1.*d* by several small compressed species, none of which appear to be identical with *S. cornucopia*, the type of the genus.

Dr. Hicks placed this genus among the Pteropods,[1] but if I am right in referring our shells to his genus, there would seem to be features indicating affinities with the Gasteropods and Heteropods rather than with the Pteropods, and I have, therefore, placed the St. John species under the Gasteropods.

The little shells of this genus are always unequilateral, and usually have a more or less prominent ridge or carina on the back. Among recent molluscs, Carinaria and Atlanta are the forms which appear to come nearest to them; in general outline they resemble the shells of the former genus, but their compressed form reminds one of those of the latter; from both, however, they differ in the straight or nearly straight apex, and in the arrangement of the lines of growth on the shell. All the species are more or less ribbed or thickened along the back, and it seems probable that in one of the species there was a suture along this line, as the sides are sometimes found detached and one side pushed past the other. The apex of two out of the five species of the St. John group is known, and does not show any tendency to a coiled form as in Carinaria, Atlanta, or any other genus of Heteropods with which it may be compared; among certain genera of Gasteropods, however, as Dentalium, Parmophorus, and Patella, similar apices may be observed.

These little Stenothecæ appear to have had thin calcareous shells, and to have been denizens of the open sea and of tranquil bays along the coast, as they are found in the fine shales of Div. 1.*c* and 1.*d* in company with Pteropods and Trilobites.

STENOTHECA HICKSIANA, n. sp. (Plate VI. Fig. 14.)

Subtriangular, with a strongly arched anterior or dorsal margin, and a nearly straight posterior or ventral margin; the line of the aperture is curved downward in the posterior

[1] Quart. Jour. Geol. Soc., May, 1875, p. 192.

third, and is nearly straight in the anterior two thirds of its length; the apex is broken off, but projected beyond the line of the ventral side.

Sculpture. This is a thin flattened shell marked by about seven prominent ridges at the dorsal side and about five at the ventral, the difference being due to the intercalation of additional ridges on the dorsal side; some of these ridges are rounded and others have sharp edges; there are no radiating striæ visible on the surface when examined with a lens of one-inch focus.

Stenotheca paupera, from the Cambrian limestone of Conception Bay, Newfoundland, has some resemblance to this species, but has not so many concentric ridges. It is not figured by Mr. Billings.

Length, from the base of the detached apex to the middle of the aperture, $2\frac{3}{4}$ mm. *Width* of aperture, $3\frac{3}{4}$ mm.

Horizon and *Locality.* In the dark grey shales of Div. 1.*d* at Porter's Brook, St. Martin's. Rare.

STENOTHECA CONCENTRICA, n. sp. (Plate VI. Fig. 11.)

Outline of the shell lenticular, more strongly arched on the dorsal than on the basal side. Dorsal slope about twice as long as the ventral. Apex depressed, projecting but little beyond the general outline of the dorsal and ventral slopes. In the shell as compressed in the shales, there is a faint rib or internal carina all around the dorsal and ventral slopes; the dorsal third is more rigid than the rest of the shell, and is divided from the lateral slope by a faint sulcus.

Sculpture. The surface is marked by numerous strong concentric ridges, which are more numerous on the dorsal than on the ventral slope, there being about twelve on the dorsal and eight on the ventral; the additional ridges are intercalated mostly at the junction of the dorsal and lateral slopes. The surface of the shell is also marked by fine concentric striæ, invisible to the naked eye, and by very fine radiating striæ scarcely visible with a lens of one-inch focus; these radiating striæ give the surface of the concentric ridges a minutely cancellate appearance.

The substance of the shell in this species is thin, and appears to be calcareous, and the flattened sides of the shell are sometimes found displaced, and one half pushed slightly past the other as if detached along the dorsal and ventral line.

This species may be compared with *Stenotheca cornucopia* of the Menevian group, but it differs from that species in its wider aperture and strongly arched dorsal slope.

Length, from summit of the dorsal curve to the middle of the aperture, $2\frac{1}{4}$ mm. *Width* of aperture, $4\frac{1}{2}$ mm.

Horizon and *Locality.* In the fine dark shales of 1.*d*, at Porter's Brook, St. Martin's. Not infrequent.

STENOTHECA RADIATA, n. sp. (Plate VI. Fig. 12.)

Outline of the shell lenticular, more strongly arched on the basal than on the upper side. Dorsal slope about three times as long as the ventral. Apex more depressed than in the preceding species; ventral slope concave. As compressed in the shale there are two sulci on the side, viz., one at the dorsal third and another dividing the middle from the ventral slope.

Sculpture. The concentric ridges are about as numerous as in the preceding species, but the radiating striæ are more distinct and more widely spread, there being about four on the dorsal third and about five indistinct striæ on the lateral third.

More numerous examples may show that this is a variety of the preceding species, but at present it appears to be distinct; although much smaller it has as many concentric ridges as *S. concentrica.*.

Length, to the middle of the aperture, $1\frac{1}{3}$ mm. *Width* of aperture, 2 mm.

Horizon and *Locality.* In the dark grey shales of Div. 1.*c*, at Porter's Brook, St. Martin's. Rare.

STENOTHECA NASUTA, n. sp. (Plate VI. Fig. 13.)

Subtriangular, with deeply concave posterior slope. Apex not known, but probably elevated. Dorsal and ventral slopes of about equal length; the dorsal convex, the ventral produced at the aperture into a projecting point. Base of the shell strongly arched.

As preserved in the shale there is a raised rib both on the dorsal and ventral slope, that on the dorsal being the wider; there are also on the sides of the shell about four rounded concentric ridges, with sharp projecting edges.

Sculpture. The surface is smooth or nearly so, except on the dorsal rib, where a number of faint striæ, concentric with the apex, are discernable with a lens.

Length, exclusive of the deficient (broken?) apex, $1\frac{3}{4}$ mm. *Width,* $3\frac{1}{2}$ mm.

Horizon and *Locality.* In the fine grey shales of Div. 1.*c*, at Hanford Brook, St. Martin's. Rare.

STENOTHECA TRIANGULARIS, n. sp. (Plate VI. Figs. 15 and 15*a*.)

Outline triangular, and apex projecting. Dorsal slope about one half longer than the ventral; the former slightly convex, the latter moderately concave; the base of the shell is straight in the middle two thirds, but deflected upward at the extremities. The apex is long, cylindrical, and pointed backward, and a narrow, smooth area extends from it half way down the ventral slope.

Sculpture. The surface is diversified by about six or more distinct, strongly elevated, concentric ridges, which are abruptly turned upward at the dorsal margin, presenting a series of tubercular elevations along the dorsal line; the outer (lower) ridges are also bent upward at the ventral margin. Each concentric ridge is traversed lengthwise by about six striæ, which are visible only with a lens. The mould of the shell exhibits a series of cavities behind the tubercles on the dorsal line.

The form of this shell is not unlike that of *S. cornucopia*, Hicks, (referred to above), but it is distinct in its less numerous concentric ridges.

Length, $3\frac{1}{4}$ mm. *Width* of aperture, 5 mm.

Horizon and *Locality.* In the fine grey shales of Div. 1.*c* at Portland, and at the same horizon on Hanford Brook, St. Martin's. Infrequent.

In the measures of Div. 1.*c* there is a larger mollusc which, though agreeing with the typical Stenothecæ in most respects, has some important points of difference. This species exhibits relations with *Metoptoma* (?) *rugosa* of the Trenton formation. It is much larger

than the true Stenothecæ, and is preserved in a different attitude in the shales. Stenothecæ proper present us with shells which have a tendency to be flattened along the vertical plane, but this species is always found in the shales compressed horizontally, or parallel to the aperture. An examination of the younger stages of growth of this shell shows a high apex and dorsal line with flattened sides, and a tendency to collapse laterally like the true Stenothecæ. While, therefore, it shows close relations with this genus in its younger stages, the adult is so different in appearance that we seem warranted in separating it as a subgenus.

Subgenus.—*PARMOPHORELLA.*

Distinguished from Stenothecæ proper by its limpet-like form and broad aperture. It also has the following characters : Apex recurved, muscular impression horse-shoe shaped, elongated, encroaching upon the enclosed space in the anterior part of the shell.

Stenotheca (Parmophorella) Acadica. (Plate VI. Figs. 10, 10*a*, *b*, and *c*.)

Discina Acadica, Hartt. Acad. Geol., 2nd Ed., p. 644.

Palæacmea (?) *Acadica*, Walcott. U. S. Geol. Surv., Bull. 10, p. 19, Pl. I. Fig. 6.

This shell was described by the late Professor C. F. Hartt as a *Discina*. Subsequently Mr. R. P. Whitfield observed that the shell substance was calcareous, and concluded that it was a gasteropod, allied to *Palæacmea* or *Metoptoma*. Mr. C. D. Walcott afterward referred it to the former genus, and subsequently to Dr. Hicks' genus, *Stenotheca*. This is where the late Mr. Billings would have placed it if one may judge from a remark in his "Palæozoic Fossils," (Vol. II. p. 78.) With this view the author coincides, except that the form so far differs from the true Stenothecæ as to deserve a subgeneric distinction.

"The following is Professor Hartt's description of the species :—"Shell elliptical in outline, sides more or less straight. Conical, but very depressed. Apex apparently central. Surface marked by a number of deep, concentric, irregular, sharp furrows, not always continuous, and often breaking up into smaller grooves, and all these seem at times to be impressed with lighter lines running nearly parallel with them.. Of the large furrows, from nine to ten may usually be counted. The whole surface of the shell is marked by a great number of delicate raised lines, radiating from the summit to the circumference, and just visible to the naked eye. The shell appears to have been thin, and is probably much compressed vertically."

The defective material in Professor Hartt's hands has lead him to misapprehend some of the characteristics of this shell. It is broadly elliptical or oval in outline, and is elevated, especially at and in front of the apex ; the apex is acutely conical, pointed backward, and is about one third from the posterior margin.

The following particulars may be added to Professor Hartt's description of this species :—The lateral and posterior slopes of the shell are concave, especially near the apex ; and the dorsal slope is convex and elevated in front of the apex. In the collapsed shells preserved in the shales, this elevated portion is defined by a narrow ridge extending along the dorsal line about one third or one quarter of the length of the shell, according to its age ; this ridge in the compressed shell often gives it the appearance of possessing two

apices, and may have led to the impression that the apex was central; in very young shells, the elongation of the layers over the front of the shell gives it a narrowly elliptical form like Parmophorus (but there is no sulcus in front.)

The internal features of this shell would indicate that its modern relatives are to be found among the Fissurellidæ. The muscular impression as observed in an immature individual, is horse-shoe shaped, elongated and directed away from the apex; the arched end is attenuated and somewhat hexagonal in outline. The space within is divided into two areas, of which the inner is lozenge-shaped posteriorly, where it encloses the apical ridge; and constricted anteriorly, where it comes opposite the enlarged limbs of the muscular impression. Outside of the muscular impression, faint concentric striæ impress the inner surface of the shell.

Except for the absence of an involute apex this shell is not unlike *Carinaropsis carinata*, Hall, of the Trenton formation;[1] it is compressed near the apex, and expands rapidly toward the aperture in a manner similar to that species, but in the way in which the concentric ridges are added it is comparable rather with *Metoptoma* (?) *rugosa*; our shell, however, is not a Metoptoma, as it is not truncated on the side beneath the apex after the manner of the Carboniferous genus so named.

Parmophorella lived in the shallow seas near the coast, if one may judge from the species of other genera associated with it, and probably was a bottom-crawler. The true Stenothecæ appear to have been more varied in their habit of life: they have not only been found in company with Parmophorella, but also in the fine shales where remains of seaweeds (?), sponges, hydrozoa, etc., are met with. A fact in reference to the variation of resembling forms like these is related by Woodward,[2] who mentions several wide limpets which assume a narrow compressed form when growing on seaweeds.

Length, *i.e.* height from apex to middle of the orifice, 7 mm. *Width*, *i.e.* length of the aperture, 12 mm.; width of the aperture, 11 mm.

Horizon and *Locality*. In the calcareous conglomerate (1.c^1) and the grey shales (1.c^2) of Div. 1.*c* at Portland and Hanford Brook, St. Martin's; also in the grey shales (1.c^2) at Ratcliff's Stream, Simonds, and at Hanford Brook, St. Martin's. Common.

HARTTIA, Walcott.

Harttia Matthewi, *Walcott.* (Plate V. Fig. 10.)

U.S. Geol. Surv., Bull. 10, p. 19, Pl. I. Fig. 3.

This unique little shell was described by Mr. Walcott in the following terms:—

"A small oval patelliform shell, having a low, broad ridge, originating on the posterior (?) side of the interior, that supports a subcordate shield-like expansion, which extends out over the anterior (?) portion of the interior when we look down into the shell. The broad base of the ridge, and the general character of the shield-like extension are well shown in the figure.

"The character of the apex is unknown, as the only representation of the genus and

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[1] Palæontology of N. York, i. 183, Pl. 40, fig. 1.

[2] Manual of the Mollusca, p. 280.

species is in the form of a cast, showing the interior of the central portion, and, around the margins, the cast of the apparently smooth outer surface.

"The interior ridge and shield-like expansion is of a peculiar character, and unlike that of any described recent or fossil form known to me. It is so well marked that there is little hesitancy in proposing a new genus for its reception. The genus may be included in the Calyptræidæ, nearest the genus *Crepidula*, if we compare the shield-like expansion with the shelf or shelly partition of the Crepidula. However close or distant its relations to the latter, it certainly appears to be the representative of the Calyptræidæ type in the Cambrian, and adds another form, showing the differentiation of the invertebrate fauna in the oldest fauna yet known on the American continent."

The above is Mr. Walcott's definition of the genus. As it is an important type, I have given his description, but can add nothing to it, as I have not met with any further examples. Its distinctness from *Stenotheca* (*Parmophorella*) *Acadica* will be seen by comparing the interior of that shell, as figured in Plate VI. Fig. 10*c*. From the smaller and typical Stenothecæ it is distinct by its mode of preservation, being entombed with the aperture wide open. The absence of concentric corrugations would also exclude it from this genus.

Length of aperture, $3\frac{1}{2}$ mm. *Width* of aperture, $2\frac{1}{2}$ mm.

Horizon and *Locality*. This can only be inferred from the association with other species, and from the probable locality, as described by Mr. Walcott. Fine grey shales of Div. 1.*c* (?) at Ratcliffe Stream, Simonds.

VII.—PHYLLOPODA ?

(*Bivalves of uncertain relationship.*)

Among the smaller fossils of the strata of Division 1 are two types that appear to belong to the Lamellibranchs or Phyllopods, but which are so minute that their characteristics cannot readily be observed. Of one it may be said that its long, straight hinge-line and weak umbones, as well as its defined border rim, render it possible that it may be a Phyllopod allied to Aptychopsis; another is described among the Brachiopods, as probably a somewhat distorted Kutorgina; and there is a third minute organism, whose relationship is still more problematical. Although the zoological position of these fossils is thus uncertain, it seems desirable to describe them here, if only for the purpose of calling attention to the existence of such peculiar forms in the early Cambrian rocks.

LEPIDITTA, n. gen.

Minute, obliquely semi-circular, or semi-elliptical bivalves, wide on the anterior half of the valve, and having a long, straight hinge line; umbones in front of the midlength of the hinge, low, or but moderately elevated; there are indications of a connecting piece, or ligament in front of the hinge line.

LEPIDITTA ALATA, n. sp. (Plate VI. Figs. 16 and 16*a*.)

Valves obliquely semi-elliptical, about one third longer than wide; hinge line straight;

umbo less than one third from the front of the valve. Tumid part of the valve occupying about one third of its length and about one half of its width ; valve flattened toward the anterior and posterior ends. A faint narrow rim is traceable around the outer edge of the valves.

The cast of the right valve has a triangular umbonal prominence, about one third from the front ; the prominence is limited in front by a sharp and deep furrow, placed at right angles to the hinge line, and extending thence toward the base of the valve ; the umbonal elevation is somewhat hollow in the middle, where it bears a sharp narrow ridge, which is directed toward the posterior margin, at an angle of 50° from the hinge line ; a faint furrow connects this ridge with the point of the umbo.

The outer surface of the valves of this species is marked by numerous concentric striæ, and by two faint radiating furrows, extending on each side of the tumid part of the valve to the basal margin.

The sharp median ridge and connected furrow, seen in the cast of the right valve of this species, are similar to those on the dorsal valves of some Brachiopods, but the position of the umbo separates it from that class of molluscs.

Length, 1 mm. *Width*, ¾ mm.

Horizon and *Locality*. In the fine, grey shales of Div. 1.*c*, at Hanford Brook, St. Martin's. Infrequent.

Lepiditta curta, n. sp. (Plate VI. Fig. 17.)

Obliquely semi-elliptical and about two sevenths longer than wide ; hinge-line nearly straight ; umbo depressed, less one quarter from the front of the valve. Valves flattened toward the base and posterior end, the anterior and posterior margins have a flattened, depressed rim ; and the front of the rim in the two valves was apparently connected by a triangular piece not bounded by distinct sutures.

The interior of this shell has roughened zones or undulations concentric to the umbo.

This organism is not unlike the crustaceans of the genus *Estheria*, but its resemblance to the preceding species, in form and hinge-characters, indicates a generic relation.

Length, 1½ mm. *Width*, 1¼ mm.

Horizon and *Locality*. In the fine dark shales of Div. 1.*d*, at Porter's Brook, St. Martin's. Rare.

LEPIDILLA, n. gen.

This peculiar little organism may be described as follows :—Bivalve (?) shell having the hinge and body of the valve, or plate, in different planes. Hinge line straight, projecting from the general contour of the shell ; umbo and hinge line separated from the body of the valve by a sinus or emargination, behind which there is a foramen.

Lepidilla anomala, n. sp. (Plate VI. Figs. 18, 18*a*. *b*. and *c*.)

General outline of the valve, or plate, nearly circular ; outline broken by the projecting umbo and the notch in front of it ; a narrow, raised margin goes round the edge of the valve, except at the anterior end.

The left (?) valve has a hollow between the tumid body of the shell and the hinge; in this hollow there is a small foramen anteriorly, and a deep furrow posteriorly; there is a low inconspicuous tubercle at each end of the hinge line, above the foramen and furrow respectively.

The notch in the right (?) valve is extended downward as a deep furrow, nearly corresponding in position to the foramen of the other valve. The inside of the valve has a raised lenticular scar, near the posterior end, and along the inner side of the scar runs a deep furrow; this furrow is deepest at the upper end, and fades out as it goes round the base of the valve. A deep and wide furrow also extends backward from the notch at the front of the valve, spreading and becoming shallow as it approaches the furrow at the posterior end of the valve.

It is somewhat doubtful if there are right and left valves to this organism, the forms figured may be variations in shape of the one valve or plate; but all are easily recognized by the peculiar twisting of the hinge from the plane of the front and lower part of the valve. The organism is found in association with the plates of *Eocystites primævus*, etc.

Diameter, 1 mm.

Horizon and Locality. In the fine dark shales of Div. 1.*c*, at Hanford Brook, St. Martins. Infrequent.

VIII.—OSTRACODA.

BEYRICHINÆ.

The genus *Beyrichia* was established in 1851, by Professor MacCoy, on the species *B. Kloedeni*, and was more accurately defined, in 1855, by Professor T. Rupert Jones. It has become the receptacle for many species of different forms, chiefly from the Silurian rocks, and from all parts of the world. To Professor Jones, science is indebted for reducing this heterogeneous assemblage to order, so that we can now view them as pertaining to three sections, designated by him respectively as *Jugosæ*, *Corrugatæ* and *Simplices.* In 1865 Professor Jones found good reasons for separating the last named section from the other *Beyrichiæ* as a new genus, *Primitia;* so that only the two first remain to form the genus *Beyrichia*, as now understood. We have therefore to deal with these two sections only, in comparing Beyrichia with the resembling forms of the Lower Cambrian of the Acadian region.

Leaving out of view *Beyrichia Holli* of the Menevian group, which, in the great width of its valves, and in apparently having the anterior end the widest, departs from the true Beyrichiæ, we find no Beyrichiæ in the Lower Cambrian beds, but the place of this genus seems to be taken by the types I am about to describe. These types (genera) agree in having a width of valve quite unusual with the Ordovician[1] and Silurian Beyrichiæ and one of the genera also differs in having the anterior end of the valve wider than the posterior; this, in its more evenly tumid valves, may be compared to the Corrugatæ; the other in its flattened valves and prominent ridges, carries to excess certain peculiarities of the Jugosæ.

[1] The system containing the Second Fauna of Barrande.

These contrasted features of the palæozoic Beyrichinæ of this Section, may be presented as follows :—

"*Beyrichiæ jugosæ.*" (*Beyrichia* in part). Valves oblong, semicircular below, somewhat flattened, crossed by three (or more) unsymmetrical ridges variable in form and continuity.—Upper Cambrian[1] to Silurian, etc.

Beyrichinæ unguiformes. (*Hipponicharion*, n. gen.) Valves, in which the breadth nearly equals the length ; broadly semi-elliptical toward the base, flattened, crossed (in the species known) by three symmetrical ridges, of which the middle one is small and inconspicuous.—Lower Cambrian.

"*Beyrichiæ corrugatæ.*" (*Beyrichia* in part.) Valves oblong, broad end posterior, semicircular below, rounded on the surface, and marked by two transverse furrows.—Ordovician to Silurian. etc.

Beyrichinæ aliformes. (*Beyrichona*, n. gen.) Valves with breadth and length nearly equal, broad end anterior, subtriangular toward the base, rounded on the surface and having two furrows, short and faintly impressed.—Lower Cambrian.

HIPPONICHARION, n. gen.

Valves wide, semi-elliptical, subequilateral ; outer area of the valve, except on the side next the hinge, strongly elevated into prominent marginal ridges ; central area, including the upper side of the valve, greatly depressed, and having an inconspicuous central ridge near the hinge line ; valves nearly equal.

HIPPONICHARION EOS, n. sp. (Plate VI. Figs. 19, 19*a* and *b*.)

The following additional characters may be indicated as specific :—

Valves regularly semi-elliptical, widest a little behind the median line, and having a more rounded curve on the anterior than on the posterior side ; the hinge line is long, and the extremities of the valve are rounded in towards it. The valves are nearly of equal size, but the left slightly overlaps the right.

About half of the valve, including the middle and upper side, is flattened and depressed below the bounding ridges ; this flattened part is triangular, rises somewhat toward the posterior border, and then suddenly descends as a shallow depression to meet the fold at the lower margin of the valve ; the flatness of this central depression is broken near the hinge line by a low ridge, which is somewhat nearer the anterior than the posterior end of the valve ; this ridge is crowned by an inconspicuous tubercle close to the hinge line, and has a narrow, thread-like ridgelet along its crest, the ridge extends toward the lower angle of the flattened space of the valve and fades out half way across it.

The anterior and posterior ridges are of about equal length ; they are high and have an abrupt slope to the central flattened area of the valve ; and a longer abrupt slope to the marginal furrow.

The margin of the valve has a narrow raised rim, which is separated from the high

[1] Supposing that *Beyrichia Angelini* belongs to this section.

part of the valve by a narrow depressed flattened furrow, the rim of the right valve fits within that of the left.

The surface of the valves appears smooth to the naked eye, but is finely granulated when viewed with a lens.

This species is remarkable for its high relief and regularly elliptical contour, at first glance it would be taken for the head-shield of a Microdiscus, from which the glabella had been removed by abrasion.

Length, $5\frac{1}{2}$ mm. *Width*, $4\frac{1}{2}$ mm.

Horizon and *Locality*. In the dark sandstones of Div. 1.b^1, at Hanford Brook, St. Martin's. Not rare.

BEYRICHONA, n. gen.

Valves nearly or quite as wide as they are long, and wider in front than behind; they have a rudely semi-circular flattened area, extending not more than half-way from the hinge line; the rest of the valve convex, and most elevated near the middle of the valve, the flattened area has several depressions which are not very prominent.

There is no central ridge (properly so called) on the valve of this genus, but there are two very small oblique ridges close to the hinge line, of which the anterior may be taken to represent the median ridge; the posterior ridgelet becomes confluent with the inner termination of the posterior ridge.

The protuberances of the surface are not so strongly marked in this genus as in that above described, or as in the true Beyrichiæ.

Beyrichona papilio, n. sp. (Plate VI. Figs. 20, 20*a*. and *b*.)

Subtriangular, acutely triangular toward the base, rounded in toward the hinge line at each end. Depressed area faintly marked, except toward the hinge-line, where it is made more prominent by the elevation of the anterior and posterior ridges; the rest of the valve is tumid, especially in the middle and toward the lower triangular extension of the valve.

The anterior furrow is triangular, narrow and deep in front, expanded and shallow behind; it is directed toward the middle of the posterior side of the valve and extends nearly half way across the valve. The posteror furrow is subtriangular, and is parallel in direction to the anterior furrow; it is narrow and distinct in front near the hinge line, and fades out toward the posterior slope of the valve.

The median ridge is low, short, narrow, very oblique, and fades out behind the tumid central part of the valve. The anterior ridge is narrowly triangular, and vanishes on the elevated centre of the valve, about two fifths of the length of the valve from its lower pointed extremity. The posterior ridge is rounded, and extends scarcely one third along the posterior side of the valve; it has a tuberculous elevation at the posterior angle of the valve, around which it turns and, as a depressed and narrow ridge, runs forward along the hinge line nearly half-way to the front of the valve.

The margin of the valve in this species does not show a distinct fold.

The surface appears smooth to the naked eye, but finely granulated under the lens.

An example of this species has been found with valves expanded, but connected along the hinge line.

Length, 3 mm. *Width* of each valve, $3\frac{1}{2}$ mm.

Horizon and *Locality*. In the sandy shales of Division $1.b^2$, at Hanford Brook, St. Martin's. Infrequent.

BEYRICHONA TINEA, n. sp. (Plate VI. Figs. 21, 21*a* and *b*.)

Rudely subtriangular, with rounded angles at the hinge line and obtusely rounded base. Depressed area extending less than half-way to the base of the valve; distinct near the hinge line, owing to the elevation of the anterior and posterior ridges; the rest of the valve is tumid, especially on the posterior side.

The anterior furrow is lunate, expanded at the hinge line, moderately impressed on the front side, but obscurely on the posterior, and does not extend half-way to the base of the valve. The posterior furrow is saucer-shaped, deepening on the posterior side, where it is most distinct, and it extends about one third toward the base of the valve.

The median ridge begins in front of the middle of the hinge line, and is very oblique, being directed toward the pit of the posterior furrow. The anterior ridge is subtriangular and is highest in the middle, whence it slopes rapidly toward the anterior angle of the valve. The posterior ridge is arched in at the upper extremity to a tuberculous prominence at the hinge, and from this point extends along the hinge line as a low ridge parallel to the median ridge.

The marginal fold is distinct, narrow, and rounded.

The surface is smooth, or minutely tuberculated, as appears from an examination with the lens. Exfoliated examples of the valves appear to show the presence of two layers of shell substance.

Beyrichia Holli, Jones, of the Menevian, in the unusual width of the valves, and in apparently having the anterior end wider than the posterior, approaches the genus *Beyrichona*, but it is much smaller than either of the species above described.

Length, 4 mm. *Width*, 4 mm.

Horizon and *Locality*. In the sandy shales of Div. $1.b^2$, at Hanford Brook, St. Martin's. Frequent.

PRIMITIA, Jones.

This genus is represented by more than one species in the rocks of the St. John group, and the author proposes to describe here a very tumid form, of which a few individuals have been found.

PRIMITIA ACADICA, n. sp. (Plate VI. Figs. 22, 22 *a*. and *b*.)

Outline of the valves elliptical-oblong, with but very slight projection at the extremities of the hinge line. The valves slope down in all directions to the margin, and the form is so symmetrical that it is difficult to ascertain which is the upper and which the lower side of the valve; but the side on which an obscure marginal fold is found, is supposed to be the lower side. It is also difficult to say which is the anterior and which the posterior end of the valve; one end has a low tubercle and a shallow pit, while the

other end is plain; this distinction may be used for the purpose of locating the characters of the inner surface of the test, as seen on the mould of the valve.

The centre of the valve is marked by a distinct circular depression, apparently a perforation of the test: from this point a faint median furrow extends toward the tuberculated end, where it fades out in the shallow pit existing at that end of the valve; this pit is larger than the circular depression at the centre of the valve, but differs from it in having no defined margin; beside this larger pit, but nearer to the margin of the valve, is the tubercle above referred to; it is low, somewhat pinched up at the sides, and elongated in the direction of the larger axis of the valve. The slope of the sides of the valve near the margin is nearly vertical, and the marginal fold is very feeble and obscure.

The surface of the valve is granulated, but the granulations are more distinct on the inner than the outer surface; the inner surface is more brilliant than the outer.

This Primitia resembles in form and size the Silurian *P. transiens*, Bar.; its apparently perforated disc recalls another Bohemian species, *P. perforata*, Bar.; in this species the perforation and tubercle are situated near the hinge line, but in ours near the axis.

Length, $3\frac{1}{2}$ mm. *Width*, 2 mm.

Horizon and *Locality*. In the conglomerate-limestone band, Div. 1.c^1, at Porter's Brook, St. Martin's.

IX.—TRILOBITA.

AGNOSTUS, Brong.

Ten species and varieties of this genus are known from Division 1. They exhibit several modifications of the generic type, and may be arranged as follows:—

1. Small species, with prominent pygidial rachis and with large glabella, having a wide fore lobe, (compare *A. rex*, Barr., and *A. regius*, Sjogr.)—one species in Div. 1.*c*.

2. Species with smooth test, smaller fore lobe to the glabella, and wider side lobes to the shield, (compare *A. fallax*, Linrs.)—three species in Div. 1.*c*, and two varieties in Div. 1.*d*.

3. Small species of high contour and obsolete or obsolescent fore lobe to the glabella, (compare *A. brevifrons*, Ang.)—two species in Div. 1.*d*.

4. Large species, having a thin, granulated test, (compare *A. punctuosus*, Ang.)—two species in Div. 1.*d*.

The *A. lævigatus* group, with obscure glabella and pygidial rachis has not yet been recognized in the Cambrian rocks of the Acadian region.

Agnostus regulus, n. sp. (Plate VII. Figs. 1*a*. *b* and *c*.)

Elongate-elliptical, with straight sides and semicircular ends.

Cephalic shield, elongate semi-elliptical with straight sides; posterior contour broken by the projecting glabella and narrow occipital ring. The width and length of the head shield are nearly equal. The dorsal furrow is distinctly, but not deeply impressed. The marginal furrow and fold are sharply defined, and the latter diminishes toward the posterior angles of the shield.

Glabella large, consisting of two lobes; the anterior, semicircular, wider than the posterior lobe, elevated above the general contour of the surface, and, in some examples undulate with broad furrows, spreading from the back of the lobe; posterior lobe flattened, cylindrical, with a broad, faint, median, transverse furrow, interrupted at the summit of the glabella by a tubercle, elongated on the line of the axis. The cheeks are narrowed in the middle, there being a crescent-shaped limb in front of the anterior lobe of the glabella, and an expanded limb on each side of the posterior lobe of the glabella.

Thorax, consisting of two (?) segments; the anterior subarcuate, and marked by five lobes that are bounded by furrows, radiating from the anterior curved margin; the inner pair of lobes are larger than the others. The posterior segment of the thorax is unknown.

The pygidium is elliptical, with straight sides and truncated in front of the side lobes; it is widest at the anterior angles. The axial lobe is large, high, obtusely clavate, constricted in the middle and divided into three lobes; the middle lobe is larger than the combined length of the anterior and posterior lobes, and bears an elongated ridge-like tubercle on the axial line; the bounding furrows are arched outward on the axial line, thus encroaching upon the other lobes; it is indented in the middle of its length on each side by a short deep furrow; the furrow at the back of this lobe is not constant in its direction, and is sometimes faint or invisible near the axial line; the anterior lobe is narrow and ring-like, the posterior is sublunate. The lateral lobes of the pygidium are narrowed opposite the posterior part of the axial lobe and more decidedly at the extremity of the pygidial shield.

This little species is remarkable for the large size of the glabella, and of the rachis of the pygidium; in these features and in the expanded anterior end of the glabella it resembles *A. rex* (Barr.) and *A. regius* (Sjogr), but there are no raised lobes on the cheeks, and the proportions of the glabella, etc., in our species differ from those of the two species cited

Length, 6 mm. *Width*, $2\frac{1}{2}$ mm.

Horizon and *Locality*. Found in the fine, dark grey shales of Div. 1.*c*, at Portland, and at Hanford Brook and Porter's Brook, St. Martin's, but it is not common.

AGNOSTUS PARTITUS, n. sp. (Plate VII. Figs. 2*a*. and *b*.)

Elongate-elliptical, broader (and subquadrate ?) behind.

Cephalic shield, elongate semi-elliptical, angulated at the posterior end. Dorsal furrow distinctly impressed. Marginal fold sharp and narrow. Glabella cylindro-conical, obtusely pointed in front, expanded at the base; anterior lobe obtusely pointed, less than a third of the whole length of the glabella; posterior lobe, strongly elevated and obtusely pointed behind; basal lobes triangular, depressed to the level of the cheeks. Cheeks somewhat narrower in front than at the sides; divided in front by a distinct furrow that connects the dorsal and marginal furrows. Thorax unknown.

A pygidium found in the same shale may belong to this species. It is subquadrate, wider behind than before, and has a pair of cusps at the outer angles. The axial lobe is nearly half as wide as the pygidium, it is about four fifths of its length and projects forward beyond the side lobes; it is obtusely lanceolate, somewhat narrowed in the middle and divided into three lobes, of which the posterior is a half longer than the length of the two anterior; the middle lobe is elevated in the middle and bears an elongated tubercle

on the axial line; there is also a faint tubercular elevation on the middle of the anterior lobe. The lateral lobes of the pygidium are somewhat narrowed in the middle of their length, by the projecting sides of the axial lobe, and rapidly behind the pygidium, where they connect. The dorsal furrow is deeply impresssed all around, and at the posterior angle is very close to the marginal furrow; this furrow is angled forward to the axial lobe, and quadrately rounded at the posterior side of the pygidium. The lateral cusps are broad and leaf-like, and the marginal fold behind them is constricted, and it is also narrowed toward and at the anterior angles of the pygidium.

The head of this little species is much like that of *A. acutiloba* (described hereafter); and, if the pygidium above described does not belong here, *partitus* may prove to be a variety of that species. Of the Scandinavian species known to me, *A. incertus*, Brögger, comes nearest this species, but differs in the proportions of the parts.

Length, 6½ mm.? *Width*, 3½ mm. Dimensions of the head shield, 2 by 2½ mm.

Horizon and *Locality*. In the grey shales of Div. 1.*c*, at Porter's Brook and Hanford Brook, St. Martin's. Infrequent.

AGNOSTUS VIR, n. sp. (Plate VII. Fig. 3.)

Body elongate-elliptical, broader and quadrate behind.

Cephalic shield elongate semi-elliptical, with straight sides, and angulated behind. Dorsal furrow distinctly impressed. Marginal fold and furrow rather flat and broad, Glabella subconical, obtuse in front, expanded behind; the width at one third from the base is about two fifths of that of the head shield, and the length about five sevenths of that of the shield; the anterior lobe of the glabella is about two fifths of its length; it is elliptically rounded in front, and obtusely rounded behind; the posterior lobe is narrowed behind, and in that part is decidedly elevated above the rest of the shield; a sigmoid furrow cuts off a depressed triangular basal lobe on each side of the glabella. The cheeks are moderately raised, and are of nearly equal width all around the glabella.

The thorax consists of two segments. The first segment is divided into three lobes, of which the outer pair is globose; the middle lobe is elongated transverse to the axis of the thorax, and is indented on the front side by two strong furrows extending half way across. The second segment of the thorax is similar to the first, except that there are no furrows on the middle lobe.

The pygidium is subquadrate, wider behind than in front, and bears a short cusp or spine at each posterior angle; its width is a fifth greater than its length. The axial lobe is cylindro-conical, obtusely pointed behind, and bears an elongated tubercle, pointed backward; at the anterior third it is about two fifths of the width of the pygidium, and it is more than three quarters of its length. The lateral lobes of the pygidium are each about half of the width of the axial lobe, and are narrowed toward the posterior end of the pygidium, where they connect. The marginal furrow increases in width, going backward as far as the posterior lateral angles, where it is as wide as the lateral lobe, but narrows again toward the extremity of the pygidium; the marginal fold increases in width from the front as far as the lateral cusps, behind which it is constricted; at the forward end it is angulated toward the axial lobe, and in the posterior third is broadly rounded.

The cephalic shield in this species is quite like that of *A. Acadicus*, Hartt, but presents

the following differences: it is proportionately narrower, and the two small lobes at the base of the glabella are larger; the pygidia of the two species are quite different. This is one of the most plentiful of the Agnosti of Div. 1.*c*, and resembles the Scandinavian species, *A. fallax*; from that species it differs in the form of the front lobe of the glabella, and in having only three lobes in the posterior segment of the thorax.

Length, 11 mm. *Width*, 5 mm.

Horizon and *Locality*. Common in the shales of Div. 1.*c*, at Portland, and at Hanford Brook, St. Martin's.

AGNOSTUS VIR, *var. α.* CONCINNUS, n. var. (Plate VII. Figs. 4*a*, *b* and *c*.)

This form is very nearly related to *A. vir*, but presents the following differences: the glabella is cylindrical, is proportionately longer, and the cross-furrow is directly transverse; the lateral lobes of the glabella are narrower. In the thorax the first segment carries five lobes, the middle lobe being segmented. In the pygidium at the anterior end of the rachis, a small triangular lobe is faintly defined on each side, and both the marginal fold and furrow are more distinct than in the type. This variety is smaller than the type.

Length, about 9 mm. *Width*, 3½ mm. Cephalic shield, 4 by 3½ mm.

Horizon and *Locality*. In the fine dark shales of Div. 1.*d*, at Porter's Brook, St. Martin's. Common.

AGNOSTUS ACADICUS, *Hartt.* (Plate VII. Figs. 5*a* and *b*.)

Acad. Geol. 2nd. Ed. pp. 655–6, Fig. 229. U. S. Geol., Surv., Bull. 10, p. 22. Pl. II. Figs. 2, 2*a*, *b* and *c*.

The late Professor C. H. Hartt described two species of Agnosti from the St. John group, that above-named and *A. similis*. Mr. C. D. Walcott, however, who has studied the type specimens of the Hartt collection now in Cornell University, finds that the latter species is founded on a narrow straight-sided test of *A. Acadicus*; and *A. similis* must, therefore, be considered as a synonym of that species. For the purpose of comparison with other forms, I give a figure of this species (*A. Acadicus*.)

Horizon and *Locality*. This species is common in the shales of Div. 1.*c*, but is not so plentiful as *A. vir*.

AGNOSTUS ACADICUS, *var. α.* DECLIVIS, n. var. (Plate VII. Figs. 6*a* and *b*.)

This form is closely allied to *A. Acadicus*, but presents the following differences: it has a narrower border fold, and smaller basal lobe to the glabella; the glabella has proportionately a longer anterior lobe, and the furrow dividing it from the posterior lobe is directly transverse; the posterior lobe is strongly elevated, almost tumid behind, and bears a small round tubercle at the middle of its length; in front of the tubercle the lobe slopes downward rapidly to the cross-furrow.

Differences of equal import are found to exist between the pygidia of the two forms. In var. *declivis*, the axial lobe is cylindro-conical, and there are three minute lobes on each margin near the anterior end; in *A. Acadicus*, the axial lobe has a more triangular form, and both head and tail shields are found of a larger size than are those of the variety.

A. declivis may be compared with the later *A. secretus*, Walcott, of the Prospect Mountain group, which it resembles in its general form, as well as in having a glabella tumid behind. Neither this variety, nor the type of *A. Acadicus*, appears to have any very near allies among the species of the Paradoxides beds of Sweden, known to the author.

Length, about 7 mm. *Width*, 3 mm. Cephalic shield, 3 by 3 mm.

Horizon and *Locality*. Abundant in the fine dark shales of Div. 1.*d*, at Porter's Brook, St. Martin's.

AGNOSTUS TESSELLA, n.sp. (Plate VII. Figs. 7 *a*, *b* and *c*.)

Body elongate-elliptical, more broadly rounded in front than behind.

Cephalic shield semi-elliptical, somewhat wider than long; high in the middle and posterior part. Dorsal furrow very marked at the posterior two thirds of the glabella, very faint at the anterior third. Marginal fold strongly elevated and the furrow deep and strongly impressed. Glabella cylindro-conical, rounded in front; the width one third of that of the shield, the length five sevenths of the shield; the anterior lobe of the glabella is depressed to the level of the cheeks, and almost obsolete; the posterior lobe is cylindrical, rounded behind, bounded in front by a straight deep furrow, and bears a small tubercle one third from the front: the two basal lobes are small and inconspicuous.

The thorax is subrectangular, emarginate in front at the axis and consists of two segments. The anterior segment bears five lobes, of which the two lateral pairs are globose; the central lobe is transversely elongated, wider behind than before, and bears a minute tubercle at the axial line. The posterior segment is similar to the anterior, except that the middle lobe is not so distinct, and has no tubercle.

The pygidium is semi-elliptical, somewhat wider than long, strongly elevated along the axis, and truncated in front at the lateral thirds. The axial lobe is cylindro-conical, its width is one half of that of the pygidium, and its length more than three quarters; it bears an elongated tubercle on the axial line at the anterior third, and short furrows indent the sides of the axial lobe, opposite the ends of this tubercle. The lateral lobes are narrow and diminish in width posteriorly; they are divided at the extremity of the axis by a furrow connecting the dorsal and marginal furrows.

This species is easily distinguished from all the preceding by its peculiar glabella and by the crenulated sides of the undivided axial lobe of the pygidium. Its nearest ally among the Scandinavian species appears to be var. *nepos* (Brög.) of *A. parvifrons*, Linrs, but the rachis of the pygidium has a different shape; the glabella of *A. tessella* differs from all the forms of *A. parvifrons* in having a distinct, though faint anterior lobe. *A. seclusus*, Walcott, of the Prospect Mountain group, belongs to the same group of Agnosti as *A. tessella*, and the next species described in this paper.

Length, 9 mm. *Width*, 4 mm.

Horizon and *Locality*. In the fine dark shales of Division 1.*d*, at Porter's Brook, St. Martin's. Common.

AGNOSTUS UMBO, n. sp. (Plate VII. Figs. 8*a*. and *b*.)

Body elliptical, broader in front than behind, high at the inner side of the head and tail shields, descending thence to the front and back.

Cephalic shield broadly-transversely elliptical, high and contracted behind, sloping from the glabella in all directions. Marginal fold and furrow strongly marked. Dorsal furrow deep. Glabella suborbicular, rounded in front and behind, bearing a small tubercle on the axial line, one third from the front; the width of the glabella is more than a third of that of the shield, and its length nearly half.

The thorax is unknown.

The pygidium is semi-elliptical, with rounded anterior corners; the width is nearly a quarter greater than the length. Both dorsal and marginal furrows are deeply impressed. The axial lobe is conical and is greatly elevated above the rest of the shield; it is slightly constricted near the anterior end, and about one third from the front bears a small tubercle. The lateral lobes of the pygidium are rounded in at the anterior end by the rapid curve of the marginal furrow; and at the posterior end are gradually narrowed, and are separated at that end by a furrow which connects the dorsal and marginal furrows. The marginal fold is rather wide at the extremity of the pygidium, and is rounded at the anterior corners.

The head-shield of *A. lævigatus*, var. *similis*, of the Scandinavian beds, resembles this species, but is narrower; both this and the other forms of *A. lævigatus*, known to me, are more elongated species than *A. umbo*; and from the typical form of *A. lævigatus* our species is easily separated by the strong dorsal furrow on the head shield,

Length, 6 mm. ? *Width*, 3 mm.

Horizon and *Locality*. In the fine dark shales of Div. 1.*d*, at Porter's Brook. First found in the shale from Porter's Farm collected by Professor L. W. Bailey.

Agnostus obtusilobus, n.sp. (Plate VII. Fig. 9.)

Body elliptical oblong.

Cephalic shield semi-elliptical, about one quarter wider than long. Dorsal furrow faintly impressed. Marginal fold and furrow strongly marked. Glabella elliptical-elongate, wider behind, rounded in front, in its widest part nearly a third of the width of the shield; narrowed at the base by two small triangular lobes; a semi-elliptical lobe at the anterior end more than one third of the length of the glabella. Occipital ring and posterior marginal fold narrow. Cheeks continuous in front of the glabella.

Thorax of two segments. The anterior segment has five lobes, of which the outer pair are globose, and the inner pair subtriangular and widest in front; the centre lobe is semi-circular, broad behind, and bears an elongate, transverse tubercle in the middle. The posterior segment has three lobes, of which each of the two lateral ones is globose, and bears minute tubercles; the central lobe is subrectangular elongate, and the middle half is traversed by an arched furrow which begins and terminates on the posterior margin of the segment.

The pygidium is semi-elliptical, about one sixth wider than long, and has the anterior margin arched forward. The marginal fold and furrow are about as distinct as those of the head shield. The axial lobe is oblanceolate, constricted in the middle, clavate, and pointed behind, about one third longer than wide; it is traversed by three furrows, of which the one near the anterior end arches forward, another near the middle arches backward, and the third at the broadest part of the axial lobe is directly transverse. The first segment of the axial lobe is narrow and elevated transversely, the second segment is

elevated lengthwise, having an elongated tubercle at the axial line; the third segment of the axial lobe is narrow like the first, and the fourth is subtriangular.

Sculpture. The surface of the test in this species has a velvety appearance, and under the lens is seen to be covered with minute granulations, the surface also is rugulose or uneven, and the test thin and more apt to be distorted than those of the two preceding species.

The parts of the body in this and the succeeding species are more frequently found connected, than are those of the preceding species; and while the species above described are usually found doubled together, this and the following species are frequently spread out at length. This species resembles *A. scarabeoides* of the Welsh Cambrian rocks, but has a narrower glabella with a more obtuse front.

Length, 11 mm. *Width*, 6 mm.

Horizon and *Locality.* In the fine dark grey shales of Div. 1.*d*, at Porter's Brook, St. Martin's. Infrequent.

Agnostus acutilobus, n. sp. (Plate VII. Fig. 10.)

Body elliptical elongate.

Cephalic shield semi-elliptical, somewhat longer than wide. Dorsal furrow lightly impressed. Marginal furrow and fold sharply defined. Glabella subconical, widest behind, obtusely pointed in front; at the widest part of the posterior lobe it is one third of the width of the head shield, and its length is about three fourths of that of the head shield; the glabella is divided into four lobes, of which the anterior is one third of its length, and is subtriangular; the posterior lobe extends to the base of the shield. It bears an elongated ridge on the anterior half, where it is higher than it is behind; two faintly marked lateral furrows are just discernible on the lateral edges of this lobe. The two basal lobes of the glabella are comparatively large; they are divided from the rest of the glabella by a sigmoid furrow, and are depressed below the level of the glabella. The occipital ring is narrow, and is concealed beneath the projecting posterior extremity of the glabella. The cheeks are somewhat full, especially in front, and are divided by a furrow that connects the dorsal and marginal furrows, and each cheek is seamed across by a fainter furrow.

The thorax consists of two segments, of which the first bears five lobes; the two outer pairs of these lobes are globose, and the central one is semicircular and is crossed in the middle by a light furrow transverse to the axis of the thorax. The second segment of the thorax has three lobes, of which the two outer are somewhat elongate, and each is marked by a light furrow; the central lobe is subrectangular, and is traversed by a furrow angulated on each side of the axis of the thorax, and beginning and terminating on the posterior side of the lobe.

The pygidium is subelliptical, and its width and length are about equal. The marginal fold and furrow are about as distinct as those of the head shield. The axis is oblanceolate, nearly half as wide as the pygidium, and its length is about four fifths of that of the pygidium; it is narrowed in the anterior third, and is crossed in that part by two transverse furrows similar in appearance and direction to those of the preceding species. The included lobe bears an elongated tubercle; the posterior lobe of the axis is conical. The lateral lobes of the pygidium are moderately elevated, and meet behind the axial lobe.

Some pygidia having an axial lobe similar to that of this species and occurring with it, possess marginal cusps. This species appears to be smooth externally, but is granulated on the inner surface of the test.

Sculpture. This species resembles *A. gibbus* (Linrs.), var. *hybridus*, Brög., but differs in having an elongated ridge on the front of the posterior lobe of the glabella, in the transverse furrows on the cheeks, and in other respects.

A. Richmondensis, Walcott, of the Prospect Mountain group, has affinities with our species, but differs in the smaller lateral lobes at the base of the glabella, and in other respects.

Length, 13 mm. *Width*, 5 mm.

Horizon and *Locality.* Frequent in the fine dark shales of Div. 1.*d*, at Porter's Brook, St. Martin's.

MICRODISCUS, Emmons.

Microdiscus punctatus (*Salter*), *var.* pulchellus, *Hartt.* (Plate VII. Figs. 12*a*, *b* and *c*.)

Microdiscus pulchellus, Hartt, mss. U. S. Geol. Surv., Bull. 10. p. 25, Pl. II. Figs. 1, 1*a*, *b* and *c*.

The following particulars may be added to the description of this form as given in Mr. Walcott's Bulletin, No. 10 :—

The short, transverse furrows on the marginal fold of the head shield differ from those of *Microdiscus Dawsoni*, in being closer together, and at about equal distances all round; these furrows do not always appear on the outer surface, but are distinct on the inner surface of the test. The short furrow, which connects the dorsal and marginal furrows in front of the glabella, is faintly continued across the anterior marginal fold.

The occipital spine is much more slender in my examples than in those of the Hartt collection, figured by Mr. Walcott ; the spine is flattened vertically, and is often seen to rise from the occipital ring at an angle of about 45° from the plane of the head shield.

In the pygidium the median lobe has, as Mr. Walcott says, eight segments, including the articulating ring ; but beside these there are three narrower and less distinctly marked segments at the extremity, which would not be observed in heads that are badly preserved. When it is one quarter grown, this variety has only seven of the large rings (including the articulating ring) in the pygidium ; this is the number which, according to Mr. Salter, marks (the adult of) *Microdiscus punctatus.* Considering that the Acadian form has ten segments in the median lobe of the pygidium, and bearing in mind the other points of difference noted by Mr. Walcott, it seems entitled to rank as a distinct variety of the European *M. punctatus.*

Mr. Walcott's measurements give nearly the extreme size attained by our variety, and more frequently it is one third smaller ; it occurs in immense numbers in certain beds of of dark grey shale in the eastern part of the St. John Basin.

Length of head-shields (without the occipital spine), 4½ mm. *Width*, 5 mm. ; length of occipital spine, 3 mm.

Length of pygidium, 4½ mm. *Width*, 5 mm. There is considerable variation in the proportion of the parts.

Horizon and *Locality*. All parts of the St. John Basin, in Div. 1.*d*, from the base upward.

MICRODISCUS PUNCTATUS, *var.* PRECURSOR, n. var. (Plate VII. Fig. 13.)

Only the head shield of this variety is known. This is more triangular than that of the type. The chief difference is in the median lobe, which is conical, and has a distinct furrow separating the occipital ring from the glabella. The inner margin of the cheek, overhanging the dorsal furrow, is nearly straight; and the marginal fold of the head shield is very narrow, and very obscurely crenulate.

Individuals of *M. pulchellus*, of the same size, do not exhibit the peculiarities of this form, and it is therefore thought to be a distinct variety.

Length of the head shield, 2 mm. *Width*, 2½ mm.

Horizon and *Locality*. In the fine, grey shales of Div. 1.c^2, at Hanford Brook, St. Martin's. Rare.

MICRODISCUS DAWSONI, *Hartt*. (Plate VII. Figs. 11*a*, *b* and *c*.)

Acad. Geo., 2nd. Ed., p. 654, Fig. 228. U.S. Geol. Surv., Bull. 10. p. 23, Pl. II. Fig. 3 and 3*a*.

This is one of the most characteristic species of the Acadian Cambrian rocks. The head shield in my examples is broadly semicircular; the glabella and cheeks slope downward in front below the level of the anterior marginal fold, which rolls upward in front as a prominent, crenulated, transverse ridge; while, posteriorly, the glabella extends backward into a stout spine, slightly hooked downward at the extremity; the two parts, *i.e.* the glabella and spine, form together a fusiform axial lobe to the shield, for the spine tapers gradually from the glabella, and the two are nearly in the same plane horizontally.

The pygidium is proportionately longer than the head shield, and has seven segments in the median lobe, and five in the lateral lobes; the axial lobe does not quite reach the posterior marginal furrow; the costæ are strongly directed backward, as on the Welsh *M. sculptus*, Hicks. Our species, however, is strongly granulated on the surface of the tests where it is raised above the general level, but not in the furrows.

Although the pygidium of our species and that of *M. sculptus* are alike, the head shields are quite different; and, as regards the fusiform axial lobe of the cephalic shield, our species might, with propriety, be compared with *Microdiscus eucentrus*, Linrs., of Sweden.

This species was gregareous, the shields being often clustered on layers of the shale.

Length of the head-shield (exclusive of the occipital spine), 2½ mm. *Width*, 3½ mm. *Length* of occipital spine, 2 mm. *Length* of pygidium, 3 mm (*Width*, 3½ mm.

Horizon and *Locality*. In the fine, grey shales of Div. 1.*c*, at Portland, at Ratcliff's Stream, Simond, and at Hanford Brook, St. Martin's, but nowhere plentiful.

AGRAULOS, Corda.

AGRAULOS (?) ARTICEPHALUS, n.sp. (Plate VII. Figs. 14*a* and *b*.)

The cephalic shield between the sutures is oblong subquadrate. Glabella large, long-ovate, somewhat pointed in front, marked by three pairs of furrows, which are directed

backward. Fixed cheek narrow, eyelobe close to the glabella, opposite the end of the third furrow, the cheeks are depressed in front of the eyes, and are united in front of the glabella; in front of the glabella, the united cheeks descend and are depressed toward the anterior margin, but no marginal fold is there visible.

The facial suture appears to be parallel in its general course to the longitudinal axis of the shield; it cuts the margin obliquely, curving inward between the margin and the eyelobe; at this part it approaches close to the glabella, and then, curving outward along the cheek, appears to return again and cut the posterior margin about as far from the glabella as the space from the front of the glabella to the apex of the head shield.[1]

The thorax tapers regularly toward the base; only the first seven segments are known; the axis is wide and high, and the rings strongly arched. The pleuræ appear to be shorter than the rings of the axis, they are strongly arched and are bent downward at the extremity. The pygidium is unknown.

This ancient trilobite appears to have been an inhabitant of sandy shores, as it has only been found imbedded in worm burrows, or coprolitic nodules, or scattered sparsely over the sandy layers of the red-streaked sandstones of Div. 1.*b*. It is remarkable for its compactness laterally, and for having the eyes close to the glabella; the eyelobes have the appearance of being directed forward, as represented in the species *Conocoryphe Lyelli*, from rocks of similar age in Wales.

Length of head-shield, 9 mm. *Width* between the facial sutures, 7 mm. Length of part of thorax preserved, 9 mm. Width, 8 mm.

Horizon and *Locality*. Found in the red-streaked sandstones, Div. 1.b^3, at Hanford Brook, St. Martin's. Infrequent.

SOLENOPLEURA, Angelin.

The author has not had time to investigate the difficult and variable species of the genus *Ptychoparia*, which occur in the St. John group. But the description of a species of the related genus, *Solenopleura*, is here inserted with the consent of Mr. J. F. Whiteaves. The species was collected from the St. John group, studied by Mr. Whiteaves, and drawn by Mr. A. H. Ford, when connected with the Geological Survey of Canada in 1878.

Solenopleura Acadica, *Whiteaves*, ms. (Plate VII. Fig. 15.)

Fourteen segments in the thorax; five or six in the pygidium.

Facial suture (as far as can be made out) agrees exactly with that of *Solenopleura* (*canaliculata*,) as figured by Angelin, Pl. VIII. page 27. The number of body segments (14) given by Angelin with a query, is the same as in ours, as well as the position of the eyes and the surface markings.

The present species seems to differ from the *S. communis*, Billings, in the position of the eye, which, in the latter species is stated to be "situated a little *in advance* of the mid-length of the head," whereas in the specimens from Porter's Stream, N. B., it is placed a little behind the middle.

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[1] There is some doubt about the course of the suture in this part, as the tests preserved do not show it clearly.

Locality. Twelve specimens, all collected by R. W. Ells, at Porter's Stream, N. B., in 1878. (*Horizon.* From Div. 1.*d.*—G. F. M.)

PARADOXIDES, Brongn.

I shall have occasion to describe three new forms which have been obtained since my last paper was written.

Paradoxides Acadicus, *var.* Suricus. (Plate VII. Fig. 16.)

Head shield between the sutures narrow and long, with a large glabella. The length is equal to the anterior transverse diameter, and is one ninth less than the width between the eyelobes.

The anterior margin is regularly arched, and the fold is separated from the glabella by a furrow connecting the two limbs of the flat area.

The glabella is one quarter longer than wide; it is regularly rounded in front and the sides are nearly straight. The greatest width is little more than a quarter from the anterior end. The furrows are deeply cut near the sides of the glabella, especially the two first, which go entirely across, but are shallow in the middle third. The first furrow connects by a flattened space on the top of the glabella with the occipital furrow; both the first and second furrows arch backward. The third and fourth furrows in some examples are as distinctly impressed as the two first. The third extends about one third across, and the fourth more than one fourth across the glabella.

The occipital ring is strongly arched backward from the posterior margin, and is elevated posteriorly; it has a well marked tubercle one third from the posterior margin; the furrow is deeply impressed in the outer quarter, but is quite shallow for the rest of the way across.

The posterior margin is strongly arched backward toward the extremity, where it is triangularly pointed. The fold is narrow, but widens somewhat toward the end, and the furrow is of nearly equal width throughout.

The fixed cheek is bounded by a parabolic curve on the outer side, and is nearly straight behind; it slopes from the posterior inner angle to the front and to the posterior outer angle. The eyelobe is continuous; it is narrow and round, and is prominent at the anterior and posterior extremities.

Sculpture. The anterior marginal fold is traversed by parallel raised lines, from six to nine in number, which anastomose at intervals; the flat area has very fine granulations. The glabella is covered with distinct granulations, and also has around the front of the dome numerous short interrupted raised lines, coarser than those of *P. Eteminicus*, but finer than the interrupted ridges found on the front of *P. lamellatus.* In young individuals, these minute interrupted ridglets cover the whole dome of the glabella as far back as the third furrow, except on the slope behind the summit, where they are replaced by granulations.

This is a very marked variety of *P. Acadicus* and may prove to be a separate species. The proportion of the glabella to the head shield between the sutures in *P. Acadicus* (type) is 1 to $2\frac{1}{3}$; in this form, it is 1 to 2. In the variety the anterior transverse diameter between the sutures is just equal to the length of the shield, in the type it is a sixth

greater. The interrupted raised lines around the dome of the glabella, and the heavy glabellar furrows deeply cut around the margin of that part of the shield, also distinguish it from the type.

The young of this variety resemble in form *P. Harknessi*, Hicks, of the Solva group of Wales.

Length of the cephalic shield, 26 mm. *Width* between the sutures, 29 mm.

Horizon and *Locality*. In the calcareous shales of Div. 1 c^1, at Portland. The type of *P. Acadicus* is mostly abundant in Div. 1.c^2, at the same place.

Paradoxides Abenacus, n. sp. (Plate VII. Figs. 17*a*, *b*, *c* and *d*.)

This is the first species with shortened eyelobes thus far recognized in the Acadian measures. The description following applies to the narrow form so far as regards the cephalic shield, and is taken from the shield of an individual of considerably less than full adult size.

The head shield between the sutures is more than a third wider than it is long; it is broadly subquadrate, with a broadly arched front, and having rounded extremities to the anterior margin, a short, moderately arched eyelobe, and sharp triangular points at the posterior angles.

The anterior marginal fold rolls down in front of the glabella, and laterally is prolonged into a strong rounded ridge, where, as seen from above, it is much wider than it is in front of the glabella. The flat area is tumid anteriorly, and is separated from the fold by a furrow which, toward the glabella, is deeper than the dorsal furrow; the tumid part of the flat area rises into a sharp ridge towards the front of the glabella.

The glabella is somewhat longer than wide, its greatest width being about one quarter from its apex (front), which is broadly rounded, and where it overhangs the anterior marginal fold. The two first glabellar furrows are strongly impressed and go across the glabella, but are fainter at the middle quarter than elsewhere. The first arches backward towards the axial line and the second less markedly so. The second furrow is arched on each side of the axial line, with the convexity on the anterior side. The third and fourth furrows do not cross the glabella, and are quite faintly marked; neither of these furrows reach the margin of the glabella; the ends of the fourth pair of furrows are separated by a space about equal to one half of the width of the glabella.

The occipital ring is nearly straight along the posterior margin in the middle half, and rounded forward at the ends; the spine or tubercle is about one third from the back of the ring; the furrow is nearly straight at the lateral third, but is strongly arched forward in the middle third, where it is more lightly impressed.

The posterior margin is arched backward towards the extremity; the fold is narrow in the inner part, but broader and flattened in the outer third; the furrow is distinct and slopes abruptly from the cheek and eyelobe, but more gently from the posterior side.

The fixed cheek is narrow, the width being only about one half of the length, and it is quadrate behind. The eyelobe is nearly half as wide as long; it is lunate, with a parabolic curve on the outer side; it does not extend so far back as the fixed cheek, and is about one quarter narrower than that part.

The cephalic shield of the broad form (or of a more mature test) differs from that

described chiefly in the following particulars :—The glabella is larger in proportion to the other parts of the shield between the sutures ; the anterior marginal fold is narrow in front and wider at the ends, and the extremity, including the suture as far as the eyelobe, is more broadly rounded ; the anterior angle of the suture approaches more closely to the glabella, which is larger and more tumid in the anterior half; the eyelobe and fixed cheek are proportionately smaller, and the posterior extension of the facial suture is shorter.

Free cheeks. The remains of this part of the test, which have so far been recovered, are not sufficient for a proper description. It may be said, however, that this species had long, slender genal spines, which were round and sharply pointed. The shell substance was thin, so that when flattened in the shale the spines present numerous transverse fractures that have the appearance of annulations or partitions.

The hypostome has the doubleur attached, and its width is about two fifths greater than its length. The doubleur is arched around the front of the large lobe of the hypostome which projects into it, narrowing it at the apex to little more than a third of its width at the extremities. The large lobe of the hypostome is transversely rhombic. The posterior end of the hypostome is subquadrate, with very short spines near the outer angles ; there is a narrow lobe at this end of the hypostome which crosses it transversely, and extends forward on each side of the posterior extremity of the large lobe.

The pygidium is rectangular, with a deep and rather angular sinus at the extremity. The width is three quarters of the length ; it is of nearly equal width from the front for more than two thirds of its length, and then narrows to two subcuspidate points. The axial lobe is about three fifths of the whole length of the pygidium, and about two thirds of its width ; it is cylindrical for half its length, and then regularly rounded to the extremity ; it has two rings, of which the anterior is most distinct ; and there are two other rings, indicated by faint furrows on the posterior lobe ; the last of these rings is quite obscure. A depression, fading out toward the extremity of the pygidium, separates the axial lobe from the lateral lobes, which have no conspicuous features.

A pygidium very like this in general form, but lacking the cuspidate points at the extremity, is perhaps that of the broad form of this species ; in it the axial lobe is more prominent and more triangular than in that described above, and the posterior margin has an oval outline.

Sculpture. The anterior marginal fold of the cephalic shield is marked by a few parallel raised lines that disappear successively from the upper surface on each side of the apex over the folded front of the shield, so that the back of the fold and its outer ends are smooth. The front two thirds and both sides of the dome, or three front glabellar lobes, are ornamented with short interrupted raised lines, rudely parallel to the periphery of the dome, and somewhat distantly placed. Numerous small tubercles are distributed over the surface of the occipital ring, and are most numerous on the middle third ; similar tubercles, but smaller and more widely separated, are found on the surface of the first lobe of the glabella, and invade the dome upon the central part of the posterior third, over which they are sparsely scattered. One or two irregular rows of similar tubercles may be observed along the outer border of the eyelobe, and tubercles may also be seen scattered over the surface of the fixed cheek, which has a scabrous surface. The posterior marginal fold has a few tubercles scattered along its surface.

The decoration of the hypostome is varied. The doubleur, or fold in front, has about

nine, nearly continuous, raised lines extending along its surface, parallel to the front margin. The large lobe of the hypostome has numerous irregularly anastomosing raised lines, which are rudely parallel to the two posterior sides of the lobe, and are, therefore, reversed along the axial line; these lines are from two to three times more numerous and closely set than those covering a corresponding space of the anterior fold or doubleur. The posterior lobe of the hypostome is smooth, but the posterior marginal fold is traversed by a number of closely set, distinct, raised lines, parallel to its outer margin.

The pygidium is smooth on the upper surface, and on the under is marked by anastomosing raised lines, that are rudely parallel to the margins of the axial lobe.

This species is near *P. Tesseni* (= *P. Bohemicus*) of Europe, but is sufficiently distinct by the features of the head shield, hypostome and pygidium. It is remarkable for its wide eyelobes.

Length of the largest complete head-shield obtained, 42 mm. *Width*, between the sutures, 55 mm. Length of a large hypostome, 36 mm.; width, 58 mm. Length of pygidium, 10 mm.; width, 7½ mm.

Horizon and *Locality*. In the fine dark shales of Div. 1.*d*, at Porter's Brook, St. Martin's.

PARADOXIDES MICMAC, *Hartt*. (Plate VII. Fig. 18.)

Acad. Geol., 1868. Fig. p. 657. Trans. Roy. Soc. Can., Vol. II. Sec. iv. p. 101.

Since my former paper was written, I have met with good examples of the cephalic shield of this species, which may be described as follows:—

The cephalic shield, 23 by 30 mm., of an immature individual, is a third wider than long between the sutures; it is also a sixth wider behind than before. The front is obtusely subpyramidal, but the posterior margin is nearly straight.

The anterior margin and fold are much as in *P. Eteminicus*, but the flat area is three times longer on the front than at the suture, and is crossed near the suture by a distinct ridge.

The glabella is nearly as wide as it is long; it is somewhat angulated in front, contracted behind, and with concave margins behind the front of the eyelobes; it is widest a little behind the anterior third. The furrows are all distinctly impressed; the first two go all across, and are directed backward: the first is faintly impressed in the middle third and the second also, for a short space on each side of the axial line. Neither of the two anterior furrows reach the margin of the glabella; the parts of the third furrow are directed forward, and are separated by about one third of the width of the glabella; the fourth pair is transverse, and its members are separated from each other by half of the width of the glabella.

The occipital ring is more than three times longer than wide, and the furrow is strongly impressed only at the outer quarters, the tubercle is about one third from the posterior margin.

The posterior margin is directed backward on each side of the glabella to the angle of the facial suture, where it terminates in a sharp triangular point. The fold is narrow and weak, but the furrow wide, especially at the extremity.

The fixed cheek is subtriangular, and is separated from the eyelobe by a distinct, well-rounded furrow. The eyelobe is narrow, rounded and unusually long, its arc being two

and a half times longer than the facial suture in front of it, and three times greater than the part of the suture behind it.

The free cheek of this species is described in Trans. Roy. Soc. Can., Vol. I. Sec. iv. p. 272, No. 5. See also Fig. 8, on Plate X.

Sculpture. The anterior marginal fold is traversed by numerous, fine, longitudinal, frequently anastomosing, raised lines; similar fine, raised lines are found on the surface of the glabella, except in the furrows, where the surface is punctate; the raised lines on the glabella are rudely parallel to its front and sides, and in well preserved examples, in which the head is about 25 mm. in length, are just visible to the naked eye. The fixed cheeks are rugulose with irregular, rounded, reticulating elevations; and the furrow dividing the cheek from the eyelobe is covered with minute tubercles.

Length of the head-shield of the largest individual observed, 60 mm. *Width* between the sutures, about 80 mm.

Horizon and *Locality.* In the grey shales of Div. 1.*c*, at Portland and at Hanford Brook, St. Martin's. Frequent.

In concluding the present paper on the St. John fauna, the author takes pleasure in acknowledging his obligations to several gentlemen for assistance received. To Professor Alpheus Hyatt, for aid in investigating the Pteropoda; to Mr. C. D. Walcott, for similar assistance with some of the Brachiopoda. Professor Jules Marcou has very kindly allowed me the use of a number of pamphlets describing the Scandinavian fossils of the Paradoxides beds, and I have been further aided in a comparison of our forms with those of Scandinavia by the gift of pamphlets on the Cambrian formation of that region from Dr. Lindstrom and Professor T. Kjerulf. To Professor T. Rupert Jones, I am under obligation for information relative to the Bivalve Entomostraca, and for papers treating of that Order. To Mr. J. F. Whiteaves, I am again indebted for access to types of Cambrian fossils in the Museum at Ottawa.

PLATE V.

FIG. 1.—*Archæocyathus* (?) *pavonoides*, n. sp., $\frac{1}{1}$.—1*a*, inside surface of tube, annulated and striated.—1*b*, outer surface dotted with cells.—1*c*, inner surface enlarged $\frac{2}{1}$.—1*d*, vertical section of the thick part of the sponge showing rows of cavities along the walls, etc. $\frac{1\frac{1}{2}}{1.}$ From Div. 1.c^2. **See p. 29.**

FIG. 2.—*Protospongia* (?) *minor*, n. sp., $\frac{4}{1}$, fragment of shale, with layers of the skeleton crossing each other at various angles. From Div. 1.c^2. **See p. 30.**

FIG. 3.—*Protospongia* (?) *minor*, var. *distans*, $\frac{2}{1}$, fragment of the shale with impression of the skeleton. From Div. 1.*d*. **See p. 30.**

FIG. 4.—*Eocoryne geminum*, n. gen. et sp., $\frac{5}{1}$, examples with full number of cusps.—4*a*, section of an example having two cusps, and showing the hollow core of the organism.—4*b*, example with three cusps and having the base broken open. From Div. 1.c^2. **See p. 31.**

FIG. 5.—*Dendrograpsus* (?) *primordialis*, n. sp., $\frac{2}{1}$, fragments with terminal branchlets.—5*a*, lower part of stem showing the root-like base.—5*b*, branchlet bearing cellules, enlarged $\frac{4}{1}$. From Div. 1.*d*. **See p. 31.**

FIG. 6.—*Protograpsus alatus*, n. gen. et sp., $\frac{2}{1}$. Fragment of the frond, in some places decorticated on the rachis, and showing cavities of the cellules. From Div. 1.*d*. **See p. 32.**

FIG. 7.—*Lingulella inflata*, n. sp., $\frac{1}{1}$, ventral valve.—7*a*. same seen in profile. From Div. 1.b^1. **See p. 33.**

FIG. 8.—*Lingulella linguloides*, n. sp., $\frac{4}{1}$.—8, dorsal valve.—8*a*, ventral valve.—8*b*, same seen in profile. From Div. 1.*d*. **See p. 34.**

FIG. 9.—*Lingulella Dawsoni*, n. sp., $\frac{3}{1}$.—9, dorsal valve.—9*a*, same seen in profile.—9*b*, ventral valve.—9*c*, same seen in profile.—9*d*, small ventral valve, showing muscular scars, etc. From Div. 1.*c*. **See p. 33.**

FIG 10.—*Harttia Matthewi*, Walcott. (A gasteropod.) Interior of the shell enlarged 12 diameters (after Walcott). From Div. 1.*c* (?). **See p. 60.**

FIG. 11.—*Linnarssonia transversa*, Hartt, sp., $\frac{5}{1}$.—11, example of the dorsal valve partly exfoliated, exposing the forked median furrows and the imprint of muscles near the hinge; also, the characteristic rhombic protuberances in front of the median ridge.—11*a*, same seen in profile.—11*b*, same seen from behind.—11*c*, ventral valve partly exfoliated, shewing internal apical boss and foramen, and two small paired bosses near the hinge line.—11*d*, same seen in profile.—11*e*, same seen from behind. From Div. 1.*d*. **See p. 35.**

FIG. 12.—*Linnarssonia misera*, Billings (?), $\frac{6}{1}$.—12, dorsal valve shortened by pressure, somewhat exfoliated, exposing the thread-like median ridge, with its delicate branches, and behind these, two minute bosses close to the hinge line.—12*a*, same seen in profile.—12*b*, same seen from behind.—12*c*, ventral valve, with faint internal boss in front of the minute foramen; also showing the false area at the hinge.—12*d*, same seen in profile.—12*e*, same seen from behind. From Div. 1.*d*. **See p. 35.**

FIG. 13.—*Acrotreta Baileyi*, n. sp., $\frac{4}{1}$,—13, dorsal valve partly foliated, exposing the median ridge with its branches, the elongated median protuberance and the large paired bosses near the hinge line.—13*a*, same seen in profile.— 13*b*, ventral valve somewhat exfoliated, showing apical pit descending backward to the foramen, and the two small paired scars in front of the apical pit; also the hinge area, with median groove behind the foramen.—13*c*, same seen in profile. From Div. 1.*d*. (?). **See p. 36.**

FIG. 14.—*Acrotreta* (?) *Gulielmi*, n. sp., $\frac{4}{1}$.—14, dorsal valve.—14*a*, same seen in profile,—14*b*, interior of dorsal valve of a young individual, enlarged $\frac{6}{1}$, exhibiting the central scar with three furrows before and three behind, radiating toward the margin; also two faint muscular (?) scars near the hinge line, and a faint rhombic depression on the median line near the front of the valve.—14*c*, ventral valve, exhibiting the shallow, apical pit, with (large ?) foramen.—14*d*, same seen in profile showing the revolute margins, corresponding to the involute margin of the dorsal valve.—14*e*, cast of the interior of a ventral valve, supposed to be of this species, exhibiting a large median lobe and flattened margins; also a ring around the foramen, and the paired muscular scars behind the apex of the shell. From Div. 1.*c*. **See p. 37.**

FIG. 15.—*Acrothele Matthewi*, Hartt, sp., $\frac{2}{1}$, interior of dorsal valve, shewing the revolute posterior margins and nail-like mesian ridge as described by Prof. Hartt; also fine striæ radiating from the umbo to the lateral and anterior margins.—15*a*, same seen in profile. From Div. 1.*c*. **See p. 39.**

FIG. 16.—*Acrothele Matthewi*, var. *prima*, $\frac{2}{1}$, ventral valve exhibiting the conical umbo close to the posterior margin.—16*a*, same seen in profile. From Div. 1.b^1. **See p. 41.**

FIG. 17.—*Acrothele Matthewi* var. *lata*, $\frac{2}{1}$, interior of ventral valve, with revolute lateral and anterior margins; two pits in front of the foramen, and four minute ones close to the hinge line; also diverging arched ridges, in pairs, on each side of the foramen, and a low ridge on each side of the foramen extending back to the hinge line.—17*a*, cast of the same seen in profile, shewing position of the umbo in this variety. From Div. 1.b^2. **See p. 41.**

FIG. 18.—*Kutorgina Latourensis*, n. sp., $\frac{2}{1}$, dorsal valve.—18*a*, same seen from behind.—18*b*, ventral valve.—18*c*, same seen from behind. From Div. 1.c^2. **See p. 42.**

FIG. 19.—*Kutorgina* (?) *pterineoides*, n. sp., $\frac{6}{1}$, (somewhat distorted if a brachiopod) shewing the peculiar hinge area. From Div. 1.c^2. **See p. 43.**

FIG. 20.—*Orthis Quacoensis*, $\frac{2}{1}$, dorsal valve.—20*a*, same seen from behind.—20*b*, ventral valve.—20*c*, same seen from behind. From Div, 1.*c*. **See p. 43.**

Plate VI.

Fig. 1.—*Hyolithes* (*Camerotheca*) *Daniana*, $\frac{1}{1}$, shewing ventral side and aperture.—1*a*, immature individual $\frac{1\frac{1}{2}}{1}$, having transverse films of oxide of iron (marking diaphragms ?) near the apex, ventral aspect.—1*b*, operculum found with this species seen from inner side, $\frac{2}{1}$.—1*c*, cast of inside of an operculum found with this species, $\frac{2}{1}$. All from Div. 1.*d*. **See p. 49.**

Fig. 2.—*Hyolithes* (*Camerotheca*) *gracilis*, n. sp., $\frac{1}{1}$, dorsal side, shewing septa near the apex, and annular lines of growth on the ventral side, toward the aperture.—2*a*, young individual, dorsal aspect, showing phragmated tube at the apex.—2*b*. operculum found in the layers of shale with this species, $\frac{2}{1}$. All from Div. 1.*d*. **See p. 50.**

Fig. 3.—*Hyolithes* (*Camerotheca*) *Micmac*, $\frac{2}{1}$, dorsal aspect shewing striated interior on the ventral side, and the funnel-shaped aperture.—3*a*, another individual flexed at the base and shewing annulations of growth, $\frac{2}{1}$.—N.B. The operculum 2*b*, if not of the preceding species probably belongs to this. Both from Div. 1.*d*. **See p. 51.**

Fig. 4.—*Diplotheca Hyattiana*, n. sp., $\frac{4}{1}$, dorsal aspect, the shell abraded and shewing the septa near the apex, and the phragmated space beside the body cavity, the diaphragms are preserved along the right side of the tube. —4*a*, profile of the same shewing the flexed apex. From Div. 1.*b*[3]. **See p. 52.**

Fig. 5.—*Diplotheca Hyattiana*, var. *caudata*, $\frac{3}{1}$, ventral aspect, shewing the flexible annulated tube at the apex.—1*a*, operculum, $\frac{3}{1}$, seen from the inside; this operculum has been found in the mouth of the shell. Both from Div. 1.*d*. **See p. 53.**

Fig. 6.—*Diplotheca Acadica*, Hartt, $\frac{2}{1}$, dorsal aspect, shewing impression resembling a siphon, also sutures of diaphragms in the body-cavity, and lateral ridges corresponding to the dorsal edges of the lateral skeleton beside the body cavity.—6*a*, operculum found in the shale with this species, seen from the inside. Both from Div. 1.*d*. **See p. 54.**

Fig. 7.—*Diplotheca Acadica*, var. *sericea*, $\frac{1}{1}$, ventral aspect.—7*a*, operculum of this variety, exterior aspect.—7*b*, same seen in profile. Both from Div. 1.*d*. **See p. 55.**

Fig. 8.—*Diplotheca Acadica*, var. *obtusa*, $\frac{1}{1}$, ventral aspect. From Div. 1.*c*. **See p. 55.**

Fig. 9.—*Diplotheca Acadica*, var. *crassa*, $\frac{1}{1}$, dorsal aspect, shell abraded and shewing the lateral edges of the phragmated space beside the body cavity, and a few septa near the apex of the shell. From Div. 1.*b*[3]. **See p. 55.**

Fig. 10.—*Stenotheca* (*Parmophorella*) *Acadica*, Hartt, sp., $\frac{3}{1}$, seen from above.—10*a*, same, lateral view.—10*b*, a more tumid individual with outer half of the shell striated only. Both from Div. 1.*c*[1].—1*c*, young individual shewing the muscular scar and other features of the interior. $\frac{6}{1}$. From Div. 1.*c*[2]. **See p. 59.**

Fig. 11.—*Stenotheca concentrica*, n. sp., $\frac{5}{1}$. From Div. 1.*d*. **See p. 57.**

Fig. 12.—*Stenotheca radiata*, n. sp., $\frac{10}{1}$. From Div. 1.*c*. **See p. 57.**

Fig. 13.—*Stenotheca nasuta*, n. sp., $\frac{5}{1}$. From Div. 1.*c*. **See p. 58.**

Fig. 14.—*Stenotheca Hicksiana*, n. sp., $\frac{4}{1}$. From Div. 1.*d*. **See p. 56.**

Fig. 15.—*Stenotheca triangularis*, n. sp., $\frac{1}{1}$, shewing the free tubular apex.—15*a*, same, aspect of the interior, with cavities along the dorsal line. From Div. 1.*c*[2]. **See p. 58.**

Fig. 16.—*Lepiditta alata*, n. gen. et sp., $\frac{20}{1}$, outer surface of the left valve,—16*a*, cast of interior of right valve. Both from Div. 1.*c*[2]. **See p. 61.**

Fig. 17.—*Lepiditta curta*, n. sp, $\frac{10}{1}$, inside of the left valve. From Div. 1.*d*. **See p. 62.**

Fig. 18.—*Lepidilla anomala*, n. gen. et sp., $\frac{15}{1}$, left valve shewing foramen and furrow.—18*a*, inside of same valve.—18*b*, right valve, interior ?—18*c*, another right valve ?. All from Div. 1.*c*[2]. **See p. 62.**

FIG. 19.—*Hipponicharion eos*, n. gen. et sp., $\frac{4}{1}$, right valve.—19*a*, longitudinal section.—19*b*, transverse section. From Div. 1.*b*[1]. **See p. 64.**

FIG. 20.—*Beyrichona papilio*, n. gen. et sp., $\frac{4}{1}$, both valves.—20*a*, transverse section of the two valves. From Div. 1.*b*[2]. **See p. 65.**

FIG. 21.—*Beyrichona tinea*, n. sp., $\frac{4}{1}$, right valve.—21*a*, longitudinal section.—21*b*, transverse section. From Div. 1.*b*[2]. **See p. 66.**

FIG. 22.—*Primitia Acadica*, n. sp., $\frac{6}{1}$, right valve?—22*a*, longitudinal section.—22*b*, transverse section. From Div. 1.*c*[1]. **See p. 66.**

PLATE VII.

FIG. 1.—*Agnostus regulus*, n. sp., $\frac{4}{1}$.—1*a*, head shield.—1*b*, pygidium.—1*c*, first segment of the thorax. From Div. 1.*c*[2]. **See p. 67.**

FIG. 2.—*Agnostus partitus*, n. sp., $\frac{4}{1}$.—2*a*, head shield.—2*b*. pygidium found with this species, aud supposed to belong to it. From Div. 1.*c*[2]. **See p. 68.**

FIG. 3.—*Agnostus vir*, n. sp., $\frac{2}{1}$. somewhat flattened, complete test. From Div. 1.*c*. **See p. 69.**

FIG. 4.—*Agnostus vir*, var. *concinnus*, $\frac{3}{1}$.—4*a*, head shield.—4*b*, pigidium.—4*c*, first segment of the thorax. From Div. 1.*d*. **See p. 70.**

FIG. 5.—*Agnostus Acadicus*, Hartt, $\frac{3}{1}$.—5*a*, head shield.—5*b*, pygidium. From Div. 1.*c*[2]. **See p. 70.**

FIG. 6.—*Agnostus Acadicus*, var. *declivis*, n. var. $\frac{4}{1}$.—6*a*, head shield.—6*b*, pygidium. From Div. 1.*d*. **See p. 70.**

FIG. 7.—*Agnostus tessella*, n. sp., $\frac{3}{1}$.—7*a*, head shield.—7*b*, pygidium.—7*c*, segments of the thorax. From Div. 1.*d*. **See p. 71.**

FIG. 8.—*Agnostus umbo*, n. sp., $\frac{4}{1}$.—8*a*, head shield.—8*b*, pygidium. From Div. 1.*d*. **See p. 71.**

FIG. 9.—*Agnostus obtusilobus*, n. sp., $\frac{2}{1}$, complete test. From Div. 1.*d*. **See p. 72.**

FIG. 10.—*Agnostus acutilobus*, n. sp., $\frac{2}{1}$, complete test. From Div. 1.*d*. **See p. 73.**

FIG. 11.—*Microdiscus Dawsoni*, Hartt, $\frac{4}{1}$.—11*a*, head shield.—11*b*, same seen in profile.—11*c*, pygidium. From Div 1.*c*[2]. **See p. 75.**

FIG. 12.—*Microdiscus punctatus*, Salter, var. *pulchellus*, Hartt, $\frac{4}{1}$.—12*a*, head shield.—12*b*, same (flattened anteriorly) seen in profile.—12*c*, pygidium. From Div. 1.*b*. **See p. 74.**

FIG. 13.—*Microdiscus punctatus*, var. *precursor*, n. var., $\frac{5}{1}$, head shield. From Div. 1.*c*[2]. **See p. 75.**

FIG. 14.—*Agraulos* (?) *articephalus*, n. sp., $\frac{2}{1}$.—14*a*, head shield.—14*b*, seven segments of the thorax. From Div. 1.*b*[3] **See p. 75.**

FIG. 15.—*Solenopleura Acadica*, n. sp., Whiteaves, $\frac{1\frac{1}{2}}{1}$, head-shield, pleura and pygidium restored. From Div. 1.*d*. **See p. 76.**

FIG. 16.—*Paradoxides Acadicus*, var. *Suricus*, n. var., $\frac{1}{1}$, head-shield. From Div. 1.*c*[1]. **See p. 77.**

FIG. 17.—*Paradoxides Abenacus*, n. sp., $\frac{2}{1}$ head shield of small individual, narrow form.—17*a*. head shield ($\frac{1}{1}$) of broad form, slightly distorted.—17*b*, hypostome ($\frac{1}{1}$) of broad form.—17*c*, pygidium ($\frac{1}{1}$) of narrow form, partly exfoliated and shewing concentric striæ of the underside.—17*d*, pygidium of the broad form (?) $\frac{2}{1}$. All from Div. 1.*d*. **See p. 78.**

FIG. 18.—*Paradoxides Micmac*, Hartt, $\frac{2}{1}$, head shield of a small individual, showing the finely striated anterior marginal fold, and front and sides of the glabella; also the rugulose cheeks and long eyelobes. From Div. 1.*c*. **See p. 80.**

V.—*Catalogue of Canadian Butterflies, with Notes on their Distribution.*

By WILLIAM SAUNDERS, London, Ont.

(Presented May 27, 1885.)

The butterflies of a country are among the first insects which attract the attention of observers of nature. Being made to adorn the day, they present the most beautiful and attractive combinations of colors ; they are found everywhere, from the extreme south to the distant north, and, being lovers of summer light and sunshine, are seen in greater abundance at those periods in the year when nature presents herself in most alluring form. Hence, in the records of the natural history of any country, we usually find early reference to its butterflies.

Amid the hardships and laborious occupations attending pioneer life in Canada, it is not surprising that the beauties of these frail denizens of the woods and fields were long unheeded. But with more leisure, came higher culture and greater refinement, the love of the beautiful both in nature and art increased, and observers were multiplied. There was, however, but little inducement to record observations to any material extent, until some opportunity of publishing them was afforded. This was not long wanting. In 1856, appeared the first number of the *Canadian Naturalist and Geologist*, the organ of the Natural History Society of Montreal, and although its first volume did not contain much relating to entomology, yet it served a good purpose, by encouraging those who had begun the study, and stimulating others to join the ranks.

In 1837, Kirby's "Fauna Boreali-Americana Insecta" appeared, a quarto volume, containing a large number of descriptions of insects captured during a journey from New York to Cumberland House. In this work, references occur to twenty species of butterflies, most of which were taken within the British possessions.

In 1840, there was published a popular work on Canadian natural history, under the title of "The Canadian Naturalist." It was a small octavo volume, written by Philip H. Gosse, since well known from his writings in natural history, who had for several years prior to this date resided in the village of Compton, in the Province of Quebec. This book consists of a series of conversations on the natural history of Lower Canada, in which are recorded observations made on twenty-six species of butterflies found in that Province.

The next record appeared in 1857, and was from the pen of Wm. Stewart D'Urban, who at that time resided in Montreal. He published several descriptive articles on Canadian butterflies, in the second volume of the *Canadian Naturalist and Geologist*, in which ten species in all were described. In these papers he endeavored to awaken an interest in the subject by describing and figuring some of the most beautiful of our common butterflies. In 1859, Mr. D'Urban removed to England, and in April, 1860, published, in the

journal above referred to, a paper on "The Natural History of the Valley of the River Rouge," in which he gives the names of twenty-one species of butterflies observed by him, and mentions three others which he had been unable to determine. In August of that year he published in the same journal, Vol. V. No. 4, "A Systematic List of Lepidoptera, collected in the vicinity of Montreal," in which he enumerates thirty species of butterflies. The stimulus given by these publications to entomological pursuits was felt not only in Quebec but also in Ontario, and was followed there by the organization in April, 1863, of the Entomological Society of Canada.

In December of that year, a committee of the members of this new Society was appointed to prepare and publish catalogues of Canadian insects. Of this committee the writer was a member, and early in 1864 the first sheet was published, containing the names of a number of the Lepidoptera. Special efforts had been taken to make the list of butterflies as complete as possible, and all the collectors then at work, in both the Upper and Lower Provinces, were appealed to for information; and, when the local lists thus obtained were brought together, it was found that the number of species of Canadian butterflies was increased to sixty-six. In the course of two or three years an additional sheet was published, which contained the names of eleven butterflies not hitherto recorded as Canadian, and in 1876 a further list appeared, containing thirteen additional names, bringing the list of butterflies up to ninety in all. These later additions included a few of the Northwestern species, but up to that time there had been very little systematic collecting in that vast region.

Since Confederation, British Columbia, which is very fertile in species of butterflies, has been laid under tribute, and, although as yet but imperfectly explored, has already added many species to our list, and that Province is now doubtless the most promising field in the Dominion for work in this department. In 1883, a list was compiled and published under the auspices of the Natural History Society of Toronto, which contained the names of one hundred and sixty-four species. During the same year, Captain Gamble Geddes proceeded to the Northwest Territories and the Rocky Mountains on a special collecting tour, and worked very assiduously. His first list, which was published in the *Canadian Entomologist* for December, 1883, contained the names of ninety-two species, which was increased by two small supplementary lists, published early in 1884, to one hundred and twenty-two. Among these, there were several species new to science, and quite a number of others which had been taken by collectors in Colorado, Nevada, and other Western States and Territories, but which had not, prior to this, been recorded as Canadian.

While distant fields have thus been harvested, the gathering has also gone on nearer home. At the last annual meeting of the Royal Society of Canada, I had the honor to present a paper in which was recorded the finding of two butterflies new to Canada on Point Pelee, in Ontario. One of these was a south-western form which is common in Texas, the other a rare insect which is found occasionally in the State of New York. The instructions lately given by the Director of the Geological and Natural History Survey of Canada to the exploring parties under his direction, to devote increased attention to the collecting of insects, has also yielded good results. Last summer, in addition to other new insects, a very beautiful new butterfly was collected by Professor J. Macoun, at Lake Nipigon. This belongs to the genus *Chionobas*, and has been named by Mr. W. H. Edwards, in honor of its discover, *Chionobas Macounii.*

The list of Canadian butterflies now presented includes the names of two hundred and nine species. Of these, we have in the genus *Papilio* thirteen, whereas our early lists contained but five; six of those recently added have been captured in British Columbia and the Rocky Mountains. There are two species of *Parnassius*, one recorded from the Northwest Territories near Alaska, the other captured by Captain Geddes, at Crow's Nest Pass. One species of *Neophasia* comes from Vancouver Island; five species have been added to *Pieris*, four of which are widely distributed, while one is eastern.

In the genus *Anthocaris* there are three species, all from the Rocky Mountains; in *Colias* nineteen species, fifteen of which are Western and Northern, nine having been collected by Captain Geddes; while in the allied genus *Terias*, we have three species, all of which have been found in Ontario. In the genus *Argynnis* there have been great additions: the early lists of eastern forms contained four species, these have been increased to five, while no less than twenty-two species have been added from the Rocky Mountains and British Columbia. The result of Captain Geddes' work has enriched this genus by the addition of twelve names, one of which is a new species. In *Melitæa* and *Phyciodes*, included in one group in the early lists with four species, the increase has been eight, most of which were captured by Geddes. In *Grapta* the increase has been five species; while in *Vanessa* and *Pyrameis* the list stands just as it was twenty-one years ago. In *Limenitis*, one has been added, and in the genera grouped under *Satyrinæ* there are many additions to note; in *Cœnonympha*, two; *Erebia*, five; *Satyrus*, four; and *Chionobas*, nine. The *Theclas* have increased from five to fifteen; five have been added to *Chrysophanus* and fifteen to *Lycæna*; while in the several genera included in the *Hesperidæ* the increase has been from thirteen to twenty-nine.

CATALOGUE.

PAPILIONIDÆ.

PAPILIO, *Linn.*

1. P. AJAX (*Linn.*), *var.* MARCELLUS, *Boisd.*, Vol. VIII. Pl. ii. Edw. But., Vol. I. Pl. iii. Can. Ent., Vol. XII. p. 211.

   In Canada this species appears to be confined to Western Ontario, from Hamilton to Amherstburg, but more especially along the shores of Lake Erie.

2. P. PHILENOR, *Linn.*, Mant. 535. Sm.-Abb., Pl. iii. Say, Am. Ent., Vol. I. Pl. i. Can. Nat. and Geol., Vol. III. p. 320. Riley, 3d Mo. Ent. Rep., p. 116. Can. Ent., Vol. XIII. p. 9.

   Occurs occasionally in Western Ontario, was taken in great abundance by Rev. C. J. S. Bethune, at West Flamborough, Ont., in 1858, and during that same year was common also about Toronto. Subsequently taken several times near Woodstock.

3. P. Machaon, *var.* Aliaska, *Scud.*, Proc. Bost. Soc. Nat. Hist., Vol. XII. p. 45. Can. Ent., Vol. XIII. p. 63. Edw. But., Vol. II. Pl. xiv.

Hab.—British America and Alaska.

4. P. Oregonia, *Edw.*, But., Vol. II. Pls. vii. xiv. Papilio, Vol. II. p. 152. Vol. III. p. 45. Proc. Bost. Soc. Nat. Hist., Vol. XXII. p. 105.

Hab.—Vancouver Island.

5. P. Zolicaon, *Bd.*, Ann. Soc. Ent. Fr., Vol. II. pp. 10, 281. Edw. But., Vol. II. Pls. vi. xiv. Streck. Lep., Pl. vi. fig. 3. Papilio, Vol. II. p. 152. Vol. III. p. 45.

Hab.—Vancouver Island.

6. P. Indra, *Reak*, Proc. Ent. Soc. Phil., Vol. VI. p. 123. Edw. But., Vol. II. Pl. ix. Str. Lep., Pl. ii. fig. 1. Putn. Proc. Dav. Acad. Nat. Sci., Vol I. p. 35.

Taken at Kootanie Pass, Rocky Mountains, by Geddes.

7. P. Brevicauda, *Saund.*, in Packard's Guide, p. 245. Edw. But., Vol. II. Pls. viii. viii B.

Originally described from specimens captured near St. John's, Newfoundland; has since been taken on the Island of Anticosti and in Quebec.

8. P. Asterias, *Fab.*, Mant. 2. Boisd.-Lec., p. 14. Pl. iv. Harris Ins., p. 263. Pl. iv. Can. Nat. and Geol., Vol. II. Pl. iii. Edw. But., Vol. II. Pl. xiv.

One of our commonest papilios, found from the Atlantic to the Pacific.

9. P. Troilus, *Linn.*, Mus. Lud. Ulr., p. 187. Bd.-Lec. p. 26. Pl. x. Can. Nat. and Geol., Vol. II. Pl. iv. Harr. Ins., p. 266. Can. Ent., Vol. I. p. 73.

Found throughout the greater part of the Dominion, but seldom in any abundance. Geddes captured specimens of this insect in the Northwest at Fort McLeod.

10. P. Turnus, *Linn.*, Mant., p. 536. Say. Am. Ent., Pl. xl. Bd.-Lec., p. 19. Pls. vi. vii. Can. Nat. and Geol., Vol. II. Pl. iii. Can. Ent., Vol. I. p. 74.; Vol. VI. p. 2. Edw. But., Vol. II. Pls. iii. iv. v. Saund. Ins. Inj. to Fruits, p. 82.

A very common butterfly throughout Canada, from Nova Scotia to the Rocky Mountains. South of Pennsylvania the female usually loses its yellow color and becomes nearly black, while the other sex retains its normal hue. The form *Glaucus* has been taken by Geddes at Fort McLeod.

11. P. Eurymedon, *Bd.*, Ann. Soc. Ent. Fr., Vol. II. p. 10. Proc. Bost. Soc. Nat. Hist., Vol. XIII. Edw. But., Vol. II. Pl. i. Str. Lep., Pl. iv. fig. 1. Psyche, Vol. II. p. 180.

Hab.—British Columbia, taken also at Fort McLeod by Geddes.

12. P. Rutulus, *Bd.*, Ann. Soc. Ent. Fr., Vol. II. pp. 10, 279. Papilio, Vol. II. pp. 112, 160; Vol. III. p. 2. Psyche, Vol. II. p. 180. Edw. But., Vol. II. Pls. xii. xiii.

Hab.—British Columbia.

13. P. Cresphontes, *Cram.*, Vol. II. pp. 165 A, 166 B. Bd.-Lec., p. 31. Pls. xii. xiii. Can. Ent., Vol. X. p. 48. Saund., Ins. Inj. to Fruits, p. 378. fig. 389.

A southern butterfly, which is moving east and north. A few years ago it was confined within a small area in the southern part of Ontario; is now found in many parts of that Province, also in Quebec and St. John, N.B.

Parnassius, *Latreille.*

14. P. Clodius, *Men.*, Cat. Mus. Petr., Vol. I. p. 73. Edw. But., Vol. I. Pl. iv.
Hab.—Northwest Territories.

15. P. Smintheus, *Doubl.-Hew.*, Gen. Di. Lep., Pl. iv. Edw. But., Vol. I. Pls. v. vi. vii.
Hab.—British America, Crows' Nest Pass, Geddes ; the dark var. *Hermodur* was taken by the same collector at Summit Pass.

PIERINÆ.

Neophasia, *Behr.*

16. N. Menapia, *Feld.*, Wien. Ent. Monat., Vol. III. p. 271. Edw. But., Vol. I. Pl. viii. Str. Lep., Pl. ii. fig. 4. Papilio, Vol. II. p. 103. Proc. Bost. Soc. Nat. Hist., Vol. XXII. p. 134.
Hab.—Vancouver Island.

Pieris, *Schrank.*

17. P. Occidentalis, *Reak*, Proc. Ent. Soc. Phil., Vol. VI. p. 133. Psyche, Vol. II. p. 184.
Hab.—Rocky Mountains to the Pacific.

18. P. Protodice, *Bd.-Lec.*, p. 45. Pl. xvii. Riley, 2nd Mo. Ent. Rep., p. 104. Can. Ent., Vol. V. p. 42.
A few years ago this was a very common butterfly in Western Ontario, but now it is comparatively rare. It has been taken at Belly River, N.W.T., by Geddes, who also found the winter form *Vernalis*, at Crow's Nest Pass, Rocky Mountains.

19. P. Napi, *Esper.*
An insect very widely distributed from Nova Scotia to the Pacific coast. The form known as *Oleracea*, (Can. Ent., Vol. V. p. 38), until recently regarded as a distinct species, is most common from Nova Scotia to Lake Superior ; found also at Kootanie, N.W. T., by Geddes. In the Northwest, the form *Casta* is prevalent.

20. P. Virginiensis, *Edw.*, Tr. Am. Ent. Soc., Vol. III. p. 13. Edw. But., Vol. I. Pl. ix.
Found in Western Ontario.

21. P. Rapæ, *Linn.*, Syst. Nat., 759. Riley, 2nd Mo. Ent. Rep., p. 107. Can. Ent., Vol. V. p. 42. U. S. Agr. Rep. 1883, p. 108.
Introduced from Europe, this species is now found throughout the greater part of the Dominion.

Anthocaris, *Boisduval.*

22. A. Hyantis, *Edw.*, Tr. Am. Ent. Soc., Vol. III. p. 205. Proc. Cal. Acad. Nat. Sci., 1878. Psyche, Vol. II. p. 183.
Taken at Kicking Horse Lake, N. W. T., by Geddes.

23. A. OLYMPIA, *Edw.*, Tr. Am. Ent. Soc., Vol. III. p. 366. Edw. But., Vol. II. Pl. i of Anthocaris.
Summit Pass, Rocky Mountains. Geddes.

24. A. AUSONIDES, *Bd.*, Ann. Soc. Ent. Fr., Vol. II. pp. 10, 286. Edw. But., Vol. II. Pl. i of Anthocaris.
Taken at Calgary, N. W. T., by Geddes.

COLIAS, *Fabricius.*

25. C. CÆSONIA, *Stoll.*, Suppl. Cram., Pl. xli. figs. 2, 2B. Bd.-Lec., p. 67. Pl. xxii.
Occasionally found in the most southerly portions of Ontario.

26. C. MEADII, *Edw.*, Tr. Am. Ent. Soc., Vol. III. p. 267. Edw. But., Vol. I. Pl. xix. Rep. Wheeler Exp., Vol. V. p. 750.
Taken at Laggan, C. P. R., N. W. T., by Geddes.

27. C. HECLA, *Lef.*, Ann. Soc. Ent. Fr., Vol. V. p. 383. Pl. ix.
Hab.—Hudson Bay.

28. C. BOOTHII, *Curt.*, App. Ross. Exp., p. 65. Pl. A. figs. 3–5.
Hab.—Arctic America.

29. C. EURYTHEME, *Bd.*, Ann. Soc. Ent. Fr., Vol. II. pp. 10, 286. Edw. But., Vols. I. Pl. xiv; II. Pl. iv of Colias. Papilio, Vol. III. pp. 182–185. Can. Ent., Vol. XII. p. 100.
Found occasionally in Ontario and Quebec; also taken east of Moose Jaw, N.W.T., by Geddes.

30. C. HAGENII, *Edw.*, Papilio, Vol. III. p. 163.
Taken at Fort McLeod, N.W.T., by Geddes.

31. C. PHILODICE, *Godt.*, Enc. Meth., Vol. IX. p. 100. Bd.-Lec., p. 64. Pl. xxi. Harris Ins., p. 272. figs. 100-102. Can. Nat. and Geol., Vol. II. Pl. iv. Can. Ent., Vols. I. p. 54; V. p. 221. Edw. But., Vol. II. Pls. ii. iii.
Found throughout the Dominion, from Nova Scotia to the eastern slope of the Rocky Mountains; one of our commonest butterflies.

32. C. ERIPHYLE, *Edw.*, Tr. Am. Ent. Soc., Vol. V. p. 202.
Hab.—British Columbia.

33. C. OCCIDENTALIS, *Scud.*, Proc. Bost. Soc. Nat. Hist., Vol. IX. p. 109. Edw. But., Vol. I. Pl. xviii.
Taken at Fort Simpson and at Edmonton, N.W.T., also in Vancouver Island. The southern form of this species, known as *Chrysomelas*, was taken by Geddes at Calgary, N.W.T.

34. C. CHRISTINA, *Edw.*, Proc. Ent. Soc. Phil., Vol. II. p. 79. Edw. But., Vol. I. Pl. xiii. Papilio, Vol. IV. p. 30. Can. Ent., Vol. XVI. p. 5.
Hab.—British America. The southern form known as *Astræa* was taken at Red Deer River, N.W.T., by Geddes.

35. C. ALEXANDRA, *Edw.*, Proc. Ent. Soc. Phil., Vol. II. p. 14. Pl. xi. Edw. But., Vol. I. Pl. xii. Rep. Wheeler. Exp., Vol. V. p. 749.
Taken in the Rocky Mountains at 5,000 feet elevation by Geddes.

36. C. EDWARDSII, *Behr.*, in But. N.A., Vol. I. Pl. xvii.
Hab.—Northwest Territories; taken at Edmonton by Geddes.

37. C. INTERIOR, *Scud.*, Proc. Bost. Soc. Nat. Hist., Vol. IX. p. 108. Fernald's But. Maine, p. 32.
Hab.—Quebec, Ontario, and throughout the Northwest to Alaska. The form *Laurentina*, Scud., described by him in Proc. Bost. Soc. Nat. Hist., Vol. XVIII. p. 4, is occasionally found in Quebec.

38. C. SCUDDERII, *Reak*, Proc. Ent. Soc. Phil., Vol. IV. p. 217. Edw. But., Vol. I. Pl. xix. Rep. Wheeler Exp., Vol. V. p. 749.
Hab.—British Columbia; found also at Kootanie, N.W.T., by Geddes.

39. C. PELIDNE, *Bd.*, Icones, Pl. viii. Bd. Spec. Gen., Vol. I. p. 644. Edw. But., Vol. II. Pl. i of Colias.
Hab.—Labrador.

40. C. PALÆNO, *Linn.*, Syst. Nat., Vol. II. p. 764. Bd. Spec. Gen., Vol. I. p. 645.
Hab.—Labrador.

41. C. CHIPPEWA, *Edw.* (HELENA). Proc. Ent. Soc. Phil., Vol. II. p. 80. Edw. But., Vol. I. Pl. xii.
Hab.—Northwest Territories.

42. C. NASTES, *Bd.*, Icones, Pl. viii. Bd. Spec. Gen., Vol. I. p. 648. Edw. But., Vol. II. Pl. i. of Colias.
Hab.—Labrador.

43. C. ELIS, *Strecker*, n. sp.
Taken at Kicking Horse summit, Rocky Mountains, by Geddes.

TERIAS, *Swainson.*

44. T. NICIPPE, *Cram.*, Vol. III. p. 210. Say. Am. Ent., Vol. II. Pl. xxx. Bd.-Lec. p. 55. Pl. xx. Can. Ent., Vol. XIII. p. 61.
Found occasionally in Western Ontario.

45. T. MEXICANA, *Bd.*, Spec. Gen., Vol. I. p. 653. Morris, Lep. N. Am., p. 36. Can. Ent., Vol. XVI. p. 51. Trans. Royal Soc. Can., Vol. II. Sec. iv. p. 235.
A single specimen was captured by the writer in 1882, at Point Pelee, Ont.

46. T. LISA, *Bd.-Lec.*, p. 53. Pl. xix. Bd. Spec. Gen., Vol. I. p. 661. Morris, Lep. N. Am., p. 34. Fernald's But. Maine, p. 32.
Found occasionally throughout Western Ontario.

NYMPHALIDÆ.

DANAINÆ.

DANAIS, *Latreille*

47. D. ARCHIPPUS, *Fab.*, Ent. Syst., Vol. III. p. 49. Sm. Abb., Pl. vi. Bd.-Lec., p. 137. Pl. xl. Harr. Ins., p. 280. Can. Ent., Vols. V. p. 4; VIII. p. 119; X. p. 224; XI. p. 239; XII. pp. 37, 38.
Common everywhere, from Nova Scotia to the Rocky Mountains.

NYMPHALINÆ.

ARGYNNIS, *Fabricius.*

48. A. LETO, *Behr.*, Proc. Cal. Acad. Nat. Sci., Vol. II. p. 173. Edw. But., Vol. I. Pl. xxix.
Taken at Fort McLeod, N.W.T., by Geddes.

49. A. CYBELE, *Fab.*, Syst. Ent., p. 516. Bd.-Lec., p. 51. Pl. xlv. Edw. But., Vol. I. Pl. xxi. Can. Ent., Vols. IV. p. 121; VI. p. 121. Fern. But. Maine, p. 38.
A common butterfly in most parts of Canada, taken at Fort Edmonton, N.W.T., by Geddes.

50. A. APHRODITE, *Fab.*, Mant., Vol. II. p. 62. Harr. Ins., p. 286, fig. 211. Edw. But., Vol. I. Pl. xxii. Can. Ent., Vol. VI. p. 121. Fern. But. Maine, p. 39.
Found from Nova Scotia to the Rocky Mountains; taken at Fort Edmonton by Geddes.

51. A. LAIS, *Edw.*, Can. Ent., Vol. XV. p. 209.
Taken at Fort Edmonton, N.W.T., by Geddes.

52. A. ATLANTIS, *Edw.*, Proc. Acad. Nat. Sci. Phil., 1862, p. 54. Packard's Guide, p. 252. Edw. But., Vol. I. Pl. xxiv. Can. Ent., Vol. IX. p. 35. Fern. But. Maine, p. 40.
Found in Quebec and the Eastern Provinces: taken also at Crow's Nest Pass, Rocky Mountains, by Geddes.

53. A. COLUMBIA, *H. Edw.*, Proc. Cal. Acad. Nat. Sci., Vol. VI. 1877. Field and Forest, Vol. III. p. 102.
Hab.—Lakes Lahache and Quesnelle, British Columbia.

54. A. BREMNERII, *Edw.*, Tr. Am. Ent. Soc., Vol. IV. p. 63. Edw. But., Vol. II. Pl. iv of Argynnis.
Hab.—British Columbia.

55. A. MONTICOLA, *Behr.*, Proc. Cal. Acad. Nat. Sci., Vol. II. p. 175. Edw. But., Vol. I. Pl. xxvii.
Taken at Summit Pass, Rocky Mountains, by Geddes.

56. A. Rhodope, *Edw.*, Tr. Am. Ent. Soc., Vol. V. p. 13. Edw. But., Vol. II. Pl. vi of Argynnis.
Hab.—British Columbia.

57. A. Coronis, *Behr.*, Proc. Cal. Acad. Nat. Sci., Vol. II. p. 173. Proc. Ent. Soc. Phil., Vol. III. p. 435.
Taken at Belly River and Crow's Nest Pass, N.W.T., by Geddes.

58. A. Nevadensis, *Edw.*, Tr. Am. Ent. Soc., Vol. III. p. 14. Edw. But., Vol. I. Pl. xxxiii.
Taken at Calgary, N.W.T., by Geddes.

59. A. Edwardsii, *Reak*, Proc. Ent. Soc. Phil., Vol. VI. p. 137. Edw. But., Vol. I. Pl. xxx.
Taken on Blackfoot Reserve, N.W.T., by Geddes.

60. A. Artonis, *Edw.*, Trans. Am. Ent. Soc., Vol. IX. p. 2.
Taken at Kootanie, N.W.T., by Geddes.

61. A Clio, *Edw.*, Tr. Am. Ent. Soc., Vol. V. p. 106.
Taken at head of Peace River and Crow's Nest Pass, N.W.T., by Geddes.

62. A. Opis, *Edw.*, Trans. Am. Ent. Soc., Vol. V. p. 105. Edw. But., Vol. II. Pl. iii of Argynnis.
Hab.—Bald Mountain, British Columbia.

63. A. Montivaga, *Behr.*, Proc. Cal. Acad. Nat. Sci., Vol. II. p. 174.
Var. *Erinna*, Edw., Can. Ent., Vol. XV. p. 33, has been taken by Geddes at Red Deer River, and var. *Arge* (?), Strecker, at Calgary, N.W.T.

64. A. Eurynome, *Edw.*, Tr. Am. Ent. Soc., Vol. IV. p. 66. Edw. But., Vol. II. Pl. i of Argynnis. Rep. Wheeler Exp., Vol. V. p. 755.
Taken at Belly River, N.W.T., by Geddes.

65. A. Myrina, *Cram.*, Vol. II. p. 189. figs. B, C. Bd.-Lec., p. 155. Pl. xlv. Harr. Ins., p. 286. fig. 112. Can. Ent., Vols. I. p. 55; VIII. p. 161; IX. p. 34. Morris, Lep. N. Am., p. 45.
A very common butterfly throughout Ontario, Quebec and Nova Scotia; taken also at Edmonton, N.W.T., by Geddes.

66 A. Triclaris, *Hub.*, Samml. Ex. Schmett, Vol. II. Rep. Wheeler Exp., Vol. V. p. 757. Proc. Bost. Soc. Nat. Hist., Vol. XVII. p. 294. Morris, Lep. N. Am., p. 48.
Hab.—Labrador. Arctic America. Taken at Mount Lefroy, N.W.T., by Geddes.

67. A. Chariclea, *Schneid.*, Neu. Mag., Vol. V. p. 588. Bd.-Lec., p. 161. Bd. Sp. Gen., Vol. I. Pl. xi. fig. 2. Morris Lep. N. Am., p. 49. Proc. Bost. Soc. Nat. Hist., Vol. XVII. p. 297.
Hab.—Labrador. Arctic America. Taken also at Crow's Nest Pass, N.W.T., by Geddes.

68. A. Butlerii, *Edw.*, Can. Ent., Vol. XV. p. 32.
Hab.—British America.

69.—A. Boisduvallii, *Somm.*, in Bd. Icon. Vol. I. p. 98. Pl. xx.
Hab.—British Columbia, taken also by Geddes at Crow's Nest Pass, Rocky Mountains.

70. A. Freya, *Thunb.*, Diss. Ins. Suec., Vol. II. p. 34. Pl. v. Morris, Lep. N. Am., p. 46. Rep. Wheeler Exp., Vol. V. p. 756. Proc. Bost. Soc. Nat. Hist., Vol. XVII. p. 299.
Hab.—British America.

71. A. Polaris, *Boisd.*, Icon., Pl. xx. Bd. Spec. Gen., Vol. I. Pl. ii. fig. 1. Bd.-Lec., p. 159. Morris, Lep. N. Am., p. 48. Proc. Bost. Soc. Nat. Hist., Vol. XVII. p. 294.
Hab.—Arctic America.

72. A. Frigga, *Thunb.*, Diss. Ins. Suec., Vol. II. p. 33. Proc. Bost Soc. Nat. Hist., Vol. XVII. p. 306.
Hab.—Labrador. Arctic America.

73. A. Improba, *Butl.*, Ent. Month. Mag., Vol. XIII. p. 206.
Hab.—Arctic America.

74. A. Bellona, *Fab.*, Syst. Ent., p. 517. Bd.-Lec., p. 164. Pl. xlv. Harris Ins., p. 287. figs. 113, 114. Scud. But. p. 143. figs. 129, 130. Papilio, Vol. I. p. 134. Fern. But. Me., p. 41.
A common butterfly throughout the greater portion of the Dominion, taken at Fort Ellis, N.W.T., by Geddes.

Euptoieta, *Doubleday*,

75. E. Claudia, *Cram.*, Vol. I. Pl. lxix. figs. E, F. Can. Ent., Vols. II. p. 163; XII. p. 231. Rep. Wheeler Exp., Vol. V. p. 750. Can. Ent., Vols. XII. p. 231; XIV. p. 219.
A single specimen was taken by John C. Jack, near Montreal, P.Q., in August, 1874; taken at Calgary, by Geddes, and at Moose Mountain by Miss F. M. Pierce.

Melitaea, *Fabricius.*

76. M. Phaeton, *Drury*, Vol. I. Pl. xxi. Bd.-Lec., p. 167. Pl. xlvii. Harris, p. 288. Fig. 115. Can. Ent., Vols. I. pp. 28, 59; II. p. 36; VI. p. 159. Edw. But., Vol. II. Pl. i of Melitæa. Papilio, Vol. IV. p. 68.
Hab.—Ontario, Quebec.

77. M. Chalcedon, *Doubl.-Hew.*, Gen. Di. Lep., Vol. I. p. 180. Pl. xxiii. Proc. Ent. Soc. Phil., Vol. I. p. 222. Edw. But., Vol. I. Pl. xxxiv. Papilio, Vol. IV. p. 63.
Taken at Garnett Ranche, N.W.T., by Geddes.

78. M. Nubigena, *Behr.*, Proc. Cal. Acad. Nat. Sci., Vol. III. p. 91. Rep. Wheeler Exp., Vol. V. p. 758.
Taken at Crow's Nest Pass, Rocky Mountains, by Geddes.

79. M. Palla, *Bd.*, Ann. Soc. Ent. Fr., Vol. II. pp. 10, 305. Proc. Cal. Acad. Nat. Sci., Vols. III. p. 88; V. p. 167. Morris, But. N. Am., p. 52.
Taken at Crow's Nest Pass, Rocky Mountains, by Geddes.

80. M. Harrisii, *Scud.*, Proc. Ess. Inst., Vol. III. p. 167. Can. Ent., Vol. IX. p. 165. Fern. But. Me., p. 45.
Found in Ontario and Quebec.

81. M. Leanira, *Bd.*, Lep. de la Cala, p. 27. Rep. Wheeler Exp., Vol. V. p. 759.
Taken at Garnett Ranche, N.W.T., by Geddes.

82. M. Geddesii, *Edw.*, n. sp.
Taken at Canmore, N.W.T., by Geddes.

Phyciodes, *Doubleday.*

83. P. Nycteis, *Doubl.-Hew.*, Gen. Di. Lep., p. 181. Pl. xxiii. Lint. Ent. Cont., Vol. I. p. 26. Proc. Am. A. A. Sci., 1874, p. 108. Can. Ent., Vols. II. p. 163; IV. p. 161; V. p. 224; XI. p. 101.
Found in Ontario and Quebec. Taken at Edmonton, by Geddes.

84. P. Carlotta, *Reak*, Proc. Ent. Soc. Phil., Vol. VI. p. 141.
Taken at Brandon, Manitoba, by Geddes.

85. P. Tharos, *Dru.*, Vol. I. Pl xxi. Bd.-Lec., p. 170. Pl. xlvii. Can. Ent., Vol. VII. p. 166.
Var. *Marcia*, Edw., Tr. Am. Ent. Soc., Vol. II. p. 207. Can. Ent., Vol. IX. p. 1. Edw. But., Vol. II. Pl. i of Phyciodes.
Var. *Packardii*, Saund., in Pack. Guide, p. 256. Edw. But., Vol. II. Pl. ii of Phyciodes, figs. 11 and 12.
Found throughout Canada from Nova Scotia to the Pacific.

86. P. Pratensis, *Behr.*, Proc. Cal. Acad. Nat. Sci., Vol. III. p. 86.
Taken at Kicking Horse Pass, Rocky Mountains, by Geddes.

87. P. Camillus, *Edw.*, Tr. Am. Ent. Soc., Vol. III. p. 268.
Taken at Edmonton, N.W.T., by Geddes.

Grapta, *Kirby.*

88. G. Interrogationis, *Fab.*, Supplt., p. 424. Harr. Ins., p. 298.
Var. *Fabricii*, Edw., Tr. Am. Ent. Soc., Vol. III. p. 5. Edw. But., Vol. I. Pl. xxxix. Can., Ent., Vol. XIV. p. 189.
Var. *Umbrosa*, Lint , Tr. Am. Ent. Soc., Vols. II. p. 313; III. p. 197. Edw. But., Vol. I. Pl. xxxviii.
Found in Ontario, Quebec and Nova Scotia.

89. G. Comma, *Harr.*, Ins., p. 300. Pl. iv. fig. 1. Lint. Proc. Ent. Soc. Phil., Vol. III. p. 55. Edw. But., Vol. I. Pl. xxxvi. Can. Ent., Vol. XIV. p. 189.
Var. *Harrisii*, Edw., Can. Ent., Vol. V. p. 184.
Var. *Dryas*, Edw., Tr. Am. Ent. Soc., Vol. III. p. 17. Edw. But., Vol. I. Pl. xxxvii.
Hab.—Ontario, Quebec, Nova Scotia.

90. G. Satyrus, *Edw.*, Tr. Am. Ent. Soc., Vol. II. p. 374. Edw. But., Vol. I. Pl. xl. Can. Ent., Vol. II. p. 216.
Found in Quebec and Ontario, taken also by Geddes at Crow's Nest Pass, Rocky Mountains.

91. G. Rusticus, *Edw.*, Tr. Am. Ent. Soc., Vol. V. p. 107. Edw. But., Vol. II. Pl. iii of Grapta.
Hab.—Vancouver Island.

92. G. Faunus, *Edw.*, Proc. Acad. Nat. Sci. Phil., Vol. I. p. 222. Edw. But., Vol. I. Pl. xxxv. Can. Ent., Vol. VII. p. 49. Fern. But. Me., p. 52.
Hab.—Quebec, Ontario, Northwest Territories.

93. G. Zephyrus, *Edw.*, Tr. Am. Ent. Soc., Vol. III. p. 16. Edw. But., Vols. I. Pl. xl; II. Pl. iii of Grapta. Rep. Wheeler Exp., Vol. V. p. 769.
Taken at Laggan, Summit, N.W.T., by Geddes.

94. G. Gracilis, *Gr.-Rob.*, Ann. New York Lyc. Nat. Hist., Vol. VIII. p. 432. Strecker's Lep., Pl. viii. fig. 14.
Hab.—Quebec, British America.

95. G. Silenus, *Edw.*, Tr. Am. Ent. Soc., Vol. III. p. 15. Edw. But., Vol. II. Pl. i of Grapta.
Hab.—Vancouver Island.

96. G. Progne, *Cram.*, Vol. I. Pl. v. figs. E. F. Bd.-Lec., p. 188. Pl. 1. Harr. Ins., p. 301. Proc. Ent. Soc. Phil., Vol. III. p. 58. Can. Ent., Vol. xi. p. 9.
Found throughout Canada, from the Atlantic to the Pacific.

97. G. J. Album, *Bd-Lec.*, p. 185, Pl. 1. Harr. Ins., p. 298. Proc. Ent. Soc. Phil., Vol. III. p. 58. Fern. But. Me., p. 54.
Found in Canada, from the Atlantic to the Pacific.

Vanessa, *Fabricius.*

98. V. Antiopa, *Linn.*, Syst. Nat., Vol. I. pp. 2, 776. Bd-Lec.., p. 173. Harr. Ins., p. 296. figs. 121, 122. Proc. Ent. Soc., Phil., Vol. III. p. 59. Can. Ent., Vol. I. p. 75. Fern. But. Me., p. 55.
Found throughout the Dominion.

99. V. Milbertii, *Godt.*, Enc. Meth., Vol. IX. p. 307. Bd-Lec., p. 187. Pl. 1. Harr. Ins., p. 302. fig. 125. Proc. Ent. Soc. Phil., Vol. III. p. 61. Can. Ent., Vol I. p. 76.
Found from Nova Scotia to the Pacific.

Pyrameis, *Doubleday.*

100. P. Atalanta, *Linn.*, Syst. Nat., Vol. I. p. 779. Harr. Ins., p. 294. fig. 120. Can. Ent., Vol. XIV. p. 229.
Found generally throughout the Dominion.

101. P. Huntera, *Fab.*, Syst. Ent., p. 499. Sm.-Abb., Pl. ix. Bd-Lec., p. 180. Pl. xlviii. Harr. Ins., p. 292. fig. 119. Proc. Ent. Soc. Phil., Vol. III. p. 63. Can. Ent., Vol. I. p. 105.
Found generally throughout the Dominion.

102. P. CARDUI, *Linn.*, Syst. Nat. Vol. I. pp. 2, 774. Bd.-Lec., p. 178. Can. Ent., Vol. I. p. 93. Am. Nat., Vol. X. pp. 392, 602.

Found generally common throughout the Dominion.

JUNONIA, *Doubleday.*

103. J. CŒNIA, *Hub.*, Samml. Ex. Schmett, Vol. II. 1816-1824. Bd.-Lec., p. 182. Pl. xlix. Morris, Lep. N. Am., p. 61. Can. Ent., Vol. XII. p. 100. Fern. But. Me., p 60.

Found occasionally in Ontario.

LIMENITIS, *Fabricius.*

104. L. URSULA, *Fab.*, Ent. Syst., Vol. III. p. 82. Sm.-Abb., Pl. x. Bd.-Lec., p. 199. Pl. liii. Can. Ent., Vol. XIII. p. 242.

Taken in Ontario.

105. L. ARTHEMIS, *Drury*, Vol. II. p. 10. Bd.-Lec., p. 202. Pl. liv. Harr. Ins., p. 283. Pl. i. Can. Ent., Vol. XII. p. 100.

Found throughout the Dominion from Nova Scotia to British Columbia.

106. L. DISIPPUS, *Godt.*, Enc. Meth., Vol. IX. p. 393. Bd.-Lec., p. 204. Pl. lv. Harr. Ins., p. 281, fig. 109. Proc. Ent. Soc. Phil., Vol. III. p. 63. Riley, 3rd Mo. Rep., p. 153. Can. Ent., Vols. III. p. 52; XI. p. 224.

Found from Nova Scotia to Ontario; taken also by Geddes at Crow's Nest Pass, Rocky Mountains.

107. L. LORQUINI, *Bd.*, Ann. Ent. Soc. Fr., Vol. II. pp. 10, 301. Edw. But., Vol. I. Pl. xliii. Rep. Wheeler Exp., Vol. V. Pl. xxxviii.

Taken at Crow's Nest Pass, Rocky Mountains, by Geddes.

SATYRINÆ.

DEBIS, *Westwood.*

108. D. PORTLANDIA, *Fab.*, Spec. Ins., Vol. II. p. 82. Bd.-Lec , p. 226. Pl. lviii. Can. Ent., Vol. XIV. p. 84. Fern. But. Me., p. 70.

Taken occasionally in Ontario.

NEONYMPHA, *Westwood.*

109. N. CANTHUS, *Bd.-Lec.*, Pl. lx. Morris, Lep. N. Am., p. 74. Can. Ent., Vol. XV. p. 64.

Hab.—Ontario, Quebec.

110. N. EURYTRIS, *Fab.*, Ent. Syst., Vol. III. p. 157. Bd.-Lec., Pl. lxi. Morris, Lep. N. Am., p. 73. Harr. Ins., p. 306. fig. 129. Can. Ent., Vols. II. p. 139; X. p. 125.

Hab.—Ontario, Quebec.

Cœnonympha, *Westwood.*

111. C. Inornata, *Edw.*, Proc. Acad. Nat. Sci. Phil., 1861, p. 163. Morris, Lep. N. Am., p. 328.
Taken at Calgary and Edmonton, N.W.T., by Geddes.

112. C. Ochracea, *Edw.*, Proc. Acad. Nat. Sci. Phil., 1861, p. 163.
Taken at Calgary and Edmonton, N.W.T., by Geddes.

113. C. Pamphiloides, *Reak*, Proc. Ent. Soc. Phil., Vol. VI. p. 146.
Hab.—British America.

Erebia, *Dalman.*

114. E. Fasciata, *Butl.*, Cat. Satyr. Br. Mus., p. 92. Pl. ii. fig. 8.
Hab.—Boreal America.

115. E. Discoidalis, *Kirby*, Faun. Bor. Amer., Vol. IV. p. 298. Pl. iii. figs. 2, 3. Morris, Lep. N. Am., p. 75.
Hab.—Boreal America.

116. E. Vesagus, *Doubl.-Hew.*, Gen. Di. Lep., p. 380. Pl. lxiv.
Hab.—British America.

117. E. Rossii, *Curt.*, App. Ross Exped., p. 67. Pl. A. fig. 7.
Hab.—Boreal America.

118. E. Disa, *Thunb.* *Mancinus*, Doubl.-Hew., Gen. Di. Lep., p. 380. Pl. liv.
Hab.—British America.

119. E. Epipsodea, *Butl.*, Cat. Satyr. Br. Mus., p. 80. Pl. ii.
Var. *Rhodia*, Edw., Tr. Am. Ent. Soc, Vol. III. p. 273.
Hab.—British America.

120. E. Sofia, *Str.*, Brooklyn Bulletin, Vol. III. p. 35.
Hab.—British America.

Satyrus, *Westwood.*

121. S. Alope, *Fab.*, Ent. Syst., Vol. III. p. 229. Bd.-Lec., p. 228. Pl. lix. Harris Ins., p. 305. fig. 127. Proc. Ent. Soc. Phil., Vol. VI. pp. 196–200. Can. Ent., Vol. XII. p. 24. Edw. But., Vol. ii. Pl. ii of Satyrus.
Hab.—New Brunswick.
Var. *Maritima*, Edw., Can. Ent., Vol. XII. p. 23. Edw. But., Vol. II. Pl. ii of Satyrus.
Hab.—Grand Manan Island, New Brunswick.
Var. *Nephele*, Kirby, Faun. Bor. Amer., Vol. IV. p. 297. Can. Ent., Vol. XII. p. 21. Edw. But., Vol. II. Pl. iii of Satyrus. Brooklyn Bulletin, Vol. VI. p. 129.
Hab.—Ontario, Quebec, British America. Taken in the Rocky Mountains by Geddes.

Var. *Olympus*, Edw., Can. Ent., Vol. XII. p. 31. Edw. But., Vol. II. Pl. iii of Satyrus.

Hab.—British America. Taken in the Rocky Mountains by Geddes.

Var. *Boopis*, Behr, Proc. Cal. Acad. Nat. Sci., Vol. III. p. 164. Can. Ent., Vol. XII. p. 54.

Taken by Geddes in the Rocky Mountains.

122. S. ARIANE, *Bd.*, Ann. Soc. Ent. Fr., Vol. II. pp. 10, 307. Morris, Lep. N. Am., p. 77. Can. Ent., Vol. XII. p. 90.

Taken by Geddes in the Rocky Mountains.

123. S. SILVESTRIS, *Edw.*, Proc. Acad. Nat. Sci. Phil., 1861, p. 162. Morris, Lep. N.Am., p. 327. *Phocus*, Edw., Tr. Am. Ent. Soc., Vol. V. p. 14.

Hab.—British Columbia. Taken also by Geddes at Garnett Ranche, N.W.T.

124. S. CHARON, *Edw.*, Tr. Am. Ent. Soc., Vol. IV. p. 69. Can. Ent., Vol. XII. p. 94. Rep. Wheeler Exp., Vol. V. p. 773.

Taken at Garnett Ranche, N.W.T., by Geddes.

CHIONOBAS, *Boisduval.*

125. C. GIGAS, *Butl.*, Cat. Satyr. Br. Mus., p. 161. Pl. ii. Edw. But., Vol. II. Pls. i. ii of Chionobas.

Hab.—Vancouver Island.

126. C. CHRYXUS, *West.-Hew.* Gen. Di. Lep., p. 283. Pl. lxiv. Rep. Wheeler Exp., Vol. V. p. 777.

Taken by Geddes at Summit, N. W. T.

127. C. CALAIS, *Scud.*, Proc. Ent. Soc. Phil., Vol. V. p. 7. Can. Ent., Vol. XV. p. 44.

Hab.—Hudson Bay.

128. C. VARUNA, *Edw.*, Can. Ent., Vol. XIV. p. 2.

Taken at Calgary, N.W.T., by Geddes.

129. C. UHLERI, *Reak*, Proc. Ent. Soc. Phil., Vol. VI. p. 143. Strecker, Pl. iv. fig. 5. Rep. Wheeler Exp., Vol. V. p. 776.

Taken at Calgary, N.W.T., by Geddes.

130. C. TARPEIA, *Esp.*, Eur. Schmett, Vol. I. Pl. lxxxiii. Butl. Cat. Satyr. Br. Mus., p. 161.

Hab.—Arctic America.

131. C. TAYGETE, *Hub.*, Samml. Ex. Schmett, 1816–1824.

Hab.—Labrador.

132. C. JUTTA, *Hub.*, Eur. Schmett, Vol. I. figs. 614, 615. Proc. Ent. Soc. Phil., Vol. V. p. 3. *Balder*, Hub., Zutr. Ex. Schmett, figs. 981, 982. Bd. Icon., Pl. xxxix.

Hab.—Quebec, Hudson Bay, Labrador. Taken also at Emerald Lake, N.W.T., by Geddes.

133. C. SEMIDEA, *Say.*, Am. Ent., Vol. I. Pl. i. Harr. Ins., p. 304. Proc. Bost. Soc. Nat. Hist., Vol. VII. p. 221. Pl. xiv. Proc. Ent. Soc. Phil., Vol. V. p. 20.
Hab.—Labrador.

134. C. CRAMBIS, *Frey.*, Neu. Beitr., Vol. V. p. 99. Pl. cccc.
Hab.—Labrador, Boreal America.

135. C. SUBHYALINA, *Curt.*, App. Ross Exp., p. 68.
Hab.—Arctic America.

136. C. MACOUNII, *Edw.*, Can. Ent., Vol. XVII. p. 74.
Taken by Prof. J. Macoun, at Lake Nipigon, 1884.

LIBYTHEINÆ.

LIBYTHEA, *Fabricius.*

137. L. BACHMANI, *Kirtl.*, Sill. Jour., 2, Vol. XIII. p. 336. Can. Ent., Vols. I. p. 25. fig. 1; XIII. p. 226. Edw. But., Vol. II. Pl. i of Libythea.
Found occasionally in Ontario.

LYCÆNIDÆ.

THECLA, *Fabricius.*

138. T. ACADICA, *Edw.*, Proc. Acad. Nat. Sci. Phil., 1862, p. 55. Edw. But., Vol. I. Pl. xlviii. Can. Ent., Vol. I. p. 95.
Found in Ontario and Quebec.

139. T. CALIFORNICA, *Edw.*, Proc. Acad. Nat. Sci. Phil., 1862, p. 223.
Hab.—Vancouver Island.

140. T. EDWARDSII, *Saund.*, Can. Ent., Vol. I. p. 99. Tr. Am. Ent. Soc., Vol. I. p. 172.
Taken in Ontario and Quebec, also at Summit, N.W.T., by Geddes.

141. T. CALANUS, *Hub.*, Samml. Ex. Schmett., Vol. I. 1806–1824. Fern. But. Me., p. 78.
Hab.—Ontario, Quebec.

142. T. ONTARIO, *Edw.*, Tr. Am. Ent. Soc., Vol. II. p. 209. Edw. But., Vol. I. Pl. xlviii.
Hab.—Ontario.

143. T. STRIGOSA, *Harr.*, Ins., p. 276. Edw. But., Vol. I. Pl. xlviii. Can. Ent., Vol. I. p. 99. Fern. But. Me., p. 77.
Found in Ontario and Quebec.

144. T. SMILACIS, *Bd.-Lec.*, p. 107. Pl. xxxiii. Morris, Lep. N. Am., p. 98. *Auburniana*, Harr., Ins., p. 277.
Found at Point Pelee, Ontario.

145. T. AUGUSTUS, *Kirby*, Faun. Bor. Amer., Vol. IV. p. 298. Pl. iii. figs 4, 5. Harr. Ins., p. 279. fig. 108. Morris, Lep. N. Am., p. 103. Fern. But. Me., p. 79.
Hab.—Ontario, Quebec, Boreal America.

146. T. IROIDES, *Bd.*, Ann. Soc. Ent. Fr., 2, Vol. X. p. 289. Morris, Lep. N. Am., p. 100. Proc. Cal. Acad. Nat. Sci., June, 1878.
Hab.—British Columbia.

147. T. IRUS, *Godt.*, Enc. Meth., Vol. IX. p. 674. Bd.-Lec., p. 101. Pl. xxxi. Morris, Lep. N. Am., p. 97. Fern. But. Me., p. 80.
Hab.—Vancouver Island.

148. T. NIPHON, *Hub.*, Zutr., Ex. Schmett, figs. 203, 204. Fitch, 4th Rep. N. Y. Ag. Soc., p. 57. Morris, Lep. N. Am., p. 97. Can. Ent., Vols. I. p. 95 ; V. xvi. p. 92. Fern. But. Maine, p. 82.
Hab.—Ontario, Quebec, Nova Scotia.

149. T. LÆTA, *Edw.*, Proc. Acad. Nat. Sci. Phil., 1862, p. 55. Edw. But., Vol. I. Pl. xlvii. Papilio, Vol. II. p. 8. Fern. But. Me., p. 83.
Hab.—Ontario, Quebec.

150. T. TITUS, *Fab.*, Ent. Syst., Vol. III. p. 297. Fern. But. Maine, p. 84. *Mopsus*, Hub., Zutr. Ex. Schmett., figs. 135, 136. Bd.-Lec., p. 109, Pl. xxxiv. Morris, Lep. N. Am., p. 102.
Hab.—Ontario, Quebec. Taken also at Old Man's River, N.W.T., by Geddes.

FENISECA, *Grote.*

151. F. TARQUINIUS, *Fab.*, Ent. Syst., Vol. III. p. 319. Fern. But. Me., p. 85. *Crataegi*, Bd.-Lec., p. 128. Pl. xxxvii. Morris, Lep. N. Am., p. 84. *Porsenna*, Scud. Proc. Ess. Inst., Vol. III. p. 163.
Hab.—Ontario, Quebec, Nova Scotia.

CHRYSOPHANUS, *Doubleday.*

152. C. DIONE, *Scud.*, Trans. Chic. Acad. Sci., Vol. I. p. 330.
Taken at Calgary, N. W. T., by Geddes.

153. C. THOE, *Bd.-Lec.*, p. 125. Pl. xxxviii. Morris, Lep. N. Am., p. 84. Can. Ent., Vols. I. p. 57 ; XVI. p. 68.
Hab.—Ontario, Quebec.

154. C. MARIPOSA, *Reak*, Proc. Ent. Soc. Phil., Vol. VI. p. 149. Str. Lep., Pl. x. figs. 25, 26.
Taken at Summit, N. W. T., by Geddes.

155. C. HELLOIDES, *Bd.*, Ann. Soc. Ent. Fr., 2, Vol. X. p. 291. Morris, Lep. N. Am., p. 86 Rep. Wheeler Exp., Vol. V. p. 780. Str. Lep., Pl. x. figs. 19, 20.
Taken at Oxley Ranche, N. W. T., by Geddes.

156. C. FLORUS, *Edw.*, Can. Ent., Vol. XV. p. 210.
Taken at Garnett's Ranche, N. W. T., by Geddes.

157. C. DORCAS, *Kirby*, Faun. Bor. Amer., Vol. IV. p. 299. Pl. iv. Morris, Lep. N. Am., p. 90.
Hab.—British America, Southern Labrador.

158. C. EPIXANTHE, *Bd.-Lec.*, p. 127. Pl. xxxviii. Harr. Ins., p. 274. Morris, Lep. N. Am., p. 85. Fern. But. Me., p. 86.
Hab.—Ontario, Quebec.

159. C. HYPOPHLEAS, *Bd.*, Ann. Soc. Ent. Fr., 2, Vol. X. p. 291. Bull. Buff. Soc. Nat. Sci., Vol. III. p. 128. *Phleas*, Bd.-Lec., p. 123. Var. *Americana*, D'Urban, Can. Nat. and Geol., Vol. V. p. 246. Harr. Ins., p. 273. Fern. But. Me., p. 87.
Found throughout Canada, from the Atlantic to the Pacific.

160. C. SIRIUS, *Edw.*, Tr. Am. Ent. Soc., Vol. III. p. 270. Edw. But., Vol. II. Pl. i of Chrysophanus. Str. Lep., Pl. x. figs. 29, 30.
Taken at Fort McLeod, N. W. T., by Geddes.

LYCÆNA, *Fabricius.*

161. L. LYCEA, *Edw.*, Proc. Ent. Soc. Phil., Vol. II. p. 507. Rep. Wheeler Exp., Vol. V. p. 785.
Taken at Stephen, Rocky Mountains, by Geddes.

162. L. FULLA, *Edw.*, Tr. Am. Ent. Soc., Vol. III. p. 194.
Hab.—Vancouver Island. Taken also in the Northwest Territories by Geddes.

163. L. SÆPIOLUS, *Bd.*, Ann. Soc. Ent. Fr., 2, Vol. X. p. 296. Morris, Lep. N. Am., p. 88.
Taken at Crow's Nest Pass, Rocky Mountains, by Geddes.

164. L. ICAROIDES, *Bd.*, Ann. Soc. Ent. Fr., 2, Vol. X. p. 297. Morris, Lep. N. Am., p. 88. Var. *Maricopa*, Reak, Proc. Acad. Nat. Sci. Phil., 1866, p. 245. *Mintha*, Edw., Tr. Am. Ent. Soc., Vol. III. p. 194.
Taken at Red Deer River, N. W. T., by Geddes.

165. L. AMICA, *Edw.*, Proc. Ent. Soc. Phil., Vol. II. p. 80.
Hab.—Mackenzie River, N. W. T.

166. L. PEMBINA, *Edw.*, Proc. Acad. Nat. Sci. Phil., 1862, p. 224. Can. Ent., Vol. I. pp. 11, 12.
Hab.—Quebec ; Slave Lake, British Columbia. Taken also at Crow's Nest Pass, Rocky Mountains, by Geddes.

167. L. PHERES, *Bd.*, Ann. Soc. Ent. Fr., 2, Vol. X. p. 297. Morris, Lep. N. Am., p. 89.
Hab.—British Columbia. Var. *Evius*, Bd., Lep. de la Cala. has been taken at Castle Mountain, N. W. T., by Geddes.

168. L. COUPERII, *Grote*, Bull. Buff. Soc. Nat. Sci., Vol. I. p. 185. *Pembina*, Str. Lep., Pl. x. figs. 10, 11.
Hab.—Anticosti, Southern Labrador.

169. L. AFRA, *Edw.*, Can. Ent., Vol. XV. p. 211.
Taken in the Saskatchewan Valley, N. W. T., by Geddes.

170. L. LYGDAMUS, *Doubl.*, Entom., p. 209. Edw. But., Vol. I. Pl. xlix. Western form, *Oro*, Scud., Can. Ent., Vol. VIII. p. 23.
Taken at Fort Ellis, N. W. T., by Geddes.

171. L. PODARCE, *Feld.*, Reise. Nov. Lep. Vol. II. p. 282. Pl. xxxv. *Tehama*, Reak, Proc. Acad. Nat. Sci. Phil., 1866, p. 246. *Orbitulus*, Str., Lep., Pl. x. fig. 16.
Taken at Canmore, N. W. T., by Geddes.

172. L. AQUILO, *Bd.*, Icon., p. 62. Pl. xii. figs. 7, 8. *Franklinii*, Curt., App. Ross. Exp., p. 69. Pl. A. figs. 8, 9. Proc. Bost. Soc. Nat, Hist., 1875, p. 17.
Hab.—Arctic America, Labrador.

173. L. RUSTICA, *Edw.*, Proc. Ent. Soc. Phil., Vol. IV. p. 203.
Taken at Fort Qu'Appelle, N. W. T., by Geddes.

174. L. SHASTA *Edw.*, Proc. Acad. Nat. Sci. Phil., 1862, p. 224. *Calchas*, Behr., Proc. Cal. Acad. Nat. Sci., Vol. III. p. 281. *Nivium*, Bd., Lep. de la Cala., p. 47. *Lupini*, Bd., Lep. de la Cala., p. 46. *Minnehaha*, Scud., Proc. Bost. Soc. Nat. Hist., Vol. XVII. p. 88.
Taken at Laggan, Rocky Mountains, by Geddes.

175. L. MELISSA, *Edw.*, Tr. Am. Ent. Soc., Vol. IV. p. 346. Rep. Wheeler Exp., Vol. V. p. 783. Pl. xxxvi. Str. Lep., Pl. x. figs. 8. 9. Papilio, Vol. IV. p. 91.
Taken at Oxley Ranche, N. W. T., by Geddes.

176. L. SCUDDERII, *Edw.*, Proc. Acad. Nat. Sci. Phil., 1861, p. 164; 1862, p. 225. Morris, Lep. N. Am., p. 329. Can. Ent., Vol. IV. p. 205.
Taken in Ontario, also in British Columbia.

177. L. ANNA, *Edw.*, Proc. Acad. Nat. Sci. Phil., 1861, p. 163. Morris, Lep. N. Am., p. 329. Str. Lep. Pl. x. figs. 4, 5. *Cajona*, Reak Proc. Ent. Soc. Phil., Vol. VI. p. 147. *Argyrotoxus*, Behr., Proc. Cal. Acad. Nat. Sci., Vol. III. p. 281. *Philemon*, Bd., Lep. de la Cala, p. 47.
Taken at Belly River, N. W. T., by Geddes.

178. L. PSEUDARGIOLUS, *Bd.-Lec.*
Winter form 1, *Lucia*, Kirby, Faun. Bor. Amer., Vol. IV. p. 299. Pl. iii. figs. 8, 9. Edw. But., Vol. II. Pl. ii of Lycæna, figs. 1, 2. Fern. But. Me., p. 89.
Hab.—Anticosti and Quebec to British America.
Winter form 2, *Marginata*, Edw., Papilio, Vol. III. p. 86. Edw. But., Vol. II. Pl. ii of Lycæna, figs. 3, 4.
Hab.—Ontario, Quebec.
Winter form 3, *Violacea*, Edw., Proc. Ent. Soc. Phil., Vol. VI. p. 201. Edw. But., Vols. I. Pl. xlix; II. Pl. ii of Lycæna, figs. 5, 6. Papilio, Vol. III. p. 86.
Hab.—Anticosti, Quebec, Ontario, British America.
Summer form, *Neglecta*, Edw., Proc. Acad. Nat. Sci. Phil., 1862, p. 56. Edw But., Vol. I. Pl. l. Can. Ent., Vols. I. p. 100; VII. pp. 81, 122; X. p. 1. Edw. But., Vol. II. Pl. ii of Lycæna, figs. 10 to 15; Pl. iii. Larva, etc.
Hab.—Ontario, Quebec.

179. L. AMYNTULA, *Bd.* Ann. Soc. Ent. Fr., 2, Vol. X. p. 294. Morris, Lep. N. Am. p. 87.
Taken at Calgary, N. W. T., by Geddes.

180. L. COMYNTAS, *Godt.*, Enc. Meth., Vol. IX. p. 660. Bd.-Lec., p. 120. Pl. xxxvi. Morris, Lep. N. Am., p. 83. Can. Ent., Vols. IV. p. 87; VIII. p. 202. Fern., But. Me., p. 91.
Hab.—Ontario, Quebec.

HESPERIDÆ.

CARTEROCEPHALUS, *Lederer.*

181. C. MANDAN, *Edw.*, Proc. Ent. Soc. Phil., Vol. II. p. 20. Pl. v. Fernald's But. Me., p. 93. *Mesapano*, Scud., Proc. Bost. Soc. Nat. Hist., Vol. XI. p. 383. *Skada*, Edw., Tr. Am. Ent. Soc., Vol. III. p. 196.
Hab.—Labrador, Quebec, Ontario.

ANCYLOXYPHA, *Felder.*

182. A. NUMITOR, *Fab.*, Ent. Syst., Vol. III. p. 334. Morris, Lep. N. Am., p. 120. Fern. But. Me., p. 94. *Puer*, Hub., Zutr. Ex. Schmett, figs. 275, 276. *Marginatus*, Harrris, Ins., p. 308.
Hab.—Ontario, Quebec.

THYMELICUS, *Speyer.*

183. T. GARITA, *Reak*, Proc. Ent. Soc. Phil., Vol. VI. p. 150. *Hylax*, Edw., Tr. Am. Ent. Soc., Vol. III. p. 274.
Taken at Fort Ellis and Laggan, N. W. T., by Geddes.

PAMPHILA, *Fab.*

184. P. MASSASOIT, *Scud.*, Proc. Essex Inst., Vol. III. p. 171.
Hab.—Ontario.

185. P. ZABULON, *Bd.-Lec.*, Pl. lxxvi. Morris, Lep. N. Am., p. 116. Fern. But. Me., p. 94. Var. *Hobomok*, Harr., Ins., p. 313. fig. 137. Can. Ent., Vol. I. p. 66. Dimorphic form female, *Pocahontas*, Scud., Proc. Essex Inst., Vol. III. p. 171.
Hab.—Quebec, Ontario. Taken also at Calgary, N. W. T., by Geddes.

186. P. OREGONIA, *Edw.*, Can. Ent., Vol. XV. p. 150.
Hab.—British America.

187. P. COLORADO, *Scud.*, Mem. Bost. Soc. Nat. His., Vol. II. p. 349. Pl. x. figs. 16–18. Var. *Idaho*, Edw., Can. Ent., Vol. XV. p. 148.
Colorado has been taken at Medicine Hat, and var. *Idaho*, at Moose Jaw. N. W. T., by Geddes.

188. P. NEVADA, *Scud.*, Mem. Bost. Soc. Nat. Hist., Vol. II. p. 347. Pl. x. figs. 1–4.
Taken at Fort McLeod, N. W. T., by Geddes.

189. P. MANITOBA, *Scud.*, Mem. Bost. Soc. Nat. Hist., Vol. II. p. 351. Pl. x. figs. 8–11.
Hab.—British Columbia, Lake Winnipeg. Taken also at Belly River, N. W. T., by Geddes.

190. P. UNCAS, *Edw.*, Proc. Ent. Soc. Phil., Vol. II. p. 19. Pl. v. ♂.
Taken at Belly River, N. W. T., by Geddes.

191. P. LEONARDUS, *Harr.*, Ins., p. 314. fig. 138. Morris, Lep. N. Am., p. 110.
Hab.—Ontario, Quebec.

192. P. OTHO, *Sm. Abb.*, Pl. xvi. Var. *Egremet*, Scud., Proc. Essex. Inst., Vol. III. p. 174. Fernald. But. Me., p. 97. *Otho*, Bd.-Lec., Pl. xvii. *Ætna*, Scud., Syst. Rev., p. 58. *Ursa*, Worth., Can. Ent., Vol. XII. p. 49.
Hab.—Ontario, Quebec.

193. P. PECKIUS, *Kirby*, Faun. Bor. Amer., Vol. IV. p. 300. Pl. iv. fig. 5. Morris, Lep. N. Am., p. 120. Fern. But. Me., p. 97. *Wamsutta*, Harr., Ins., p. 318. fig. 141.
Hab.—Ontario, Quebec.

194. P. MYSTIC, *Scud.*, Proc. Essex. Inst., Vol. III. p. 172. Proc. Ent. Soc. Phil., Vol. II. p. 15. Pl. i. Fern. But. Me., p. 98.
Hab.—Ontario, Quebec.

195. P. CERNES, *Bd.-Lec.*, Pl. lxxvi. Fern. But. Me., p. 99. *Ahaton*, Harr., Ins., p. 317. fig. 140.
Hab.—Ontario, Quebec. Taken at Crow's Nest Pass, Rocky Mountains, by Geddes.

196. P. MANATAAQUA, *Scud.*, Proc. Essex. Inst., Vol. III. p. 175. Fern. But. Me., p. 100. *Cernes*, Harr., Ins., p. 316.
Hab.—Ontario. Taken at Fort McLeod, N.W.T., by Geddes.

197. P. METACOMET, *Harr.*, Ins., p. 317. Fernald But. Me., p. 100, *Rurea*, Edw., Proc. Acad. Nat. Sci., Phil., 1862, p. 58.
Hab.—Ontario, Quebec.

198. P. DION, *Edw.*, Can. Ent., Vol. II. p. 238.
Taken at Hamilton, Ontario, by Mr. Moffat.

199. P. VIATOR, *Edw.*, Proc. Ent. Soc. Phil., Vol. IV. p. 202. Pl. i.
Taken at Hamilton, Ontario, by Mr. Moffat.

AMBLYSCIRTES, *Speyer.*

200. A. VIALIS, *Edw.*, Proc. Acad. Nat. Sci. Phil., 1862, p. 58. Fern. But. Me., p. 101.
Hab.—Quebec. Taken also at Fort Ellis, N.W.T., by Geddes.

201. A. SAMOSET, Scud., Proc. Essex. Inst., Vol. III. p. 176. Fern. But. Me., p. 102. *Hegon*, Scud., Pr. Ess. Inst., Vol. III. p. 176. *Nemoris*, Edw., Proc. Ent. Soc. Phil., Vols. II. p. 507; IV. Pl. i. *Alternata*, Gr.-Rob., Tr. Am. Ent. Soc., Vol. I. p. 3
Hab.—Ontario, Quebec.

PYRGUS, *Westwood.*

202. P. TESSELLATA, *Scud.*, Syst. Rev., p. 52 *Oileus*, Humph.-West., Brit. But., Pl. xxxviii, 1841. *Communis*, Grote, Can. Ent., Vol. IV. pp. 69, 220. Var. *Montivagus*, Reak, Proc, Acad. Nat. Sci. Phil., 1866, p. 46.
Hab.—Ontario. Taken also at Medicine Hat, N. W. T., by Geddes.

203. P. CENTAUREÆ, *Ramb.*, Faun. Ent. And., Pl. viii. fig. 10. *Ruralis*, Bd., Ann. Soc. Ent. Fr., 2, Vol. X. p. 311. Morris, Lep. N. Am., p. 121. *Wyandot*, Edw., Proc. Ent. Soc. Phil., Vol. II. p. 21. Pl. v.
Hab.—Labrador.

NISONIADES, *Speyer.*

204. N. BRIZO, *Bd.-Lec.*, Pl. lxvi. Morris, Lep. N. Am., p. 114. Harr. Ins., p. 309. fig. 132. Fern. But. Me., p. 102.
Hab.—Quebec, Ontario. Taken also at Fort Ellis, N. W. T., by Geddes.

205. N. ICELUS, *Lint.*, 23rd Rep. N. Y. St. Cab. Nat. Hist., 1872, p. 162. Lint. Ent. Cont., Vol. I. p. 30. Pl. vii. figs. 5, 6. Papilio, Vol. I. p. 72. Fern. But. Me., p. 103.
Hab.—Ontario.

206. N. JUVENALIS, *Fab.*, Ent. Syst., Vol. III. p. 339. Sm.-Abb., Pl. xxi. Bd.-Lec., Pl. lxv. Harr. Ins., p. 309. Morris, Lep. N. Am., p. 114.
Hab.—Ontario, Quebec.

EUDAMUS, *Swainson.*

207. E. ELECTRA, *Lintn.*, Can. Ent., Vol. XIII. p. 63.
Taken at Hamilton, Ontario, by Mr. Moffat.

208. E. PYLADES, *Scud.*, Proc. Bost. Soc. Nat. Hist., Vol. XIII. p. 207. Fern. But. Me., p. 104. *Bathyllus*, Harr., Ins., p. 312. fig. 135.
Hab.—Ontario, Quebec. Taken also at Fort Ellis, N. W. T., by Geddes.

209. E. TITYRUS, *Fab.*, Syst. Ent., p. 532. Sm-Abb., Pl. xix. Bd-Lec., Pl. lxxii. Fitch, 5th Rep, N. Y. Agr. Soc., 1859, p. 152. Morris, Lep. N. Am., p. 112. Harr. Ins., p. 310. figs. 133, 134, and Pl. v. fig. 1.
Hab.—Quebec, Ontario, British America.

In compiling the above catalogue, free use has been made of the material contained in the new revision of the List of Butterflies of America, north of Mexico, recently published by W. H. Edwards. In the arrangement of species, also, this list has been closely followed.

VI.—*On the Skull and Auditory Organ of the Siluroid Hypophthalmus.*

By R. RAMSAY WRIGHT, University College, Toronto.

(Read May 25, 1885.)

The group of fishes generally ranked as the family *Siluridæ* still offers a wide field to the comparative anatomist, notwithstanding the numerous investigations which their bizarre appearance and singular anatomical features have invited. Although, as observed by Professor Gill, (No. 2, p. xlv), the group is really a natural one and strongly contrasts with any other, there is no other "family" of Teleosts in which such wide limits of structural difference exist. As these differences are such as are considered of family value in other cases, there can be no question of the desirableness of expressing this in a system of classification, by assigning to the Siluroids a higher than family rank. This appears to be recognized by those ichthyologists who have adopted Professor Cope's ordinal name, *Nematognathi*, for the group. Günther's subdivision of the Siluroids rests primarily on the development and position of the rayed dorsal fin. He distinguishes eight sub-families and seventeen groups. Cope recognizes three families in the order *Nematognathi*, viz., the Siluridæ, Aspredinidæ, and Hypophthalmidæ; while Gill separates from Cope's Siluridæ eight aberrant types under distinct families, using the term *Siluridæ* in a narrower sense, for the forms embraced under Günther's sub-families, *S. heteropteræ*, *proteropteræ*, and *stenobranchiæ*.

Our North American fresh waters contain some thirty species, ranged under the genera *Noturus*, *Leptops*, *Gronias*, *Amiurus*, and *Ictalurus*, all of which are closely related and belong to the sub-family *S. proteropteræ* and group *Bagrina* of Günther. The anatomy of the cat-fishes constituting this very homogeneous section has been sufficiently illustrated in the "Contributions to the Anatomy of Amiurus," published by myself and some former pupils, but much remains to be done in regard to the forms with which the tropical fresh waters of the Old and New Worlds teem.

One of the little known Siluroid types is the Brazilian genus *Hypophthalmus*, Spix; of one species of which *H. marginatus*, Cuv. et Val., I have recently had the opportunity of studying two specimens through the kindness of Professors B. G. Wilder and Alex. Agassiz.

Ichthyologists are familiar with the fact that Hypophthalmus has been accorded a somewhat isolated position among the Siluroids on account of the (supposed) absence of the air-bladder and non-fusion of the anterior vertebræ. Thus Günther (No. 4) forms for the genus a distinct sub-family and group, mentioning as its essential characteristic that "the anterior vertebræ are not united into one."

Again, Cope (No. 1, p. 331) establishes for the genus one of three families, into which he divides the Nematognathi, and recognizes the great morphological importance of the

structural peculiarities attributed to the genus by even hesitating to associate it with the order. Finally, Gill (*loc. cit.* p. 18) reserves for the genus one of his eleven families of Nematognathi.

The object of the present paper is to show that Hypophthalmus possesses an air-bladder connected with the auditory organ by intervention of a Weberian apparatus, formed of parts of the anterior vertebræ modified after precisely the same plan as in the other Siluroids; but that the apparatus in question and the air-bladder exhibit an extreme reduction recalling that in the genera, *Loricaria* and *Hypostomus.* To the late Dr. Sagemehl (No. 6) belongs the credit of insisting upon the view that the presence of a Weberian apparatus implies community of descent; as he observes, it is quite impossible to conceive of so elaborate a mechanism having been developed independently within the group of the Physostomi more than once. I have elsewhere indicated (No. 11) that Baudelot was the first to give correct homologies for the osseous structures involved in the Weberian apparatus of the Cyprinoids, and to assert that in the Siluroids it is constructed on the same type. The full demonstration of this was furnished by myself in regard to the genus *Amiurus.* In extending to the Characinidæ and Gymnotidæ the demonstration of the morphological identity of the Weberian apparatus, Sagemehl recalls that by Valenciennes it was only considered analogous in the various families, and that even by Joh. Müller the structural differences of the apparatus in the families possessing it were more emphasized than its morphological identity. There can be no question of the accuracy of Sagemehl's view, and it may confidently be anticipated that in all the forms of Nematognathi, Plectospondyli (Jordan, No. 12, pp. 111 and 882), and Gymnonoti, an air-bladder will either be found or at any rate a profound modification of the anterior vertebræ, showing that its absence is secondary. Sagemehl proposes to unite under the designation *Ostariophyseæ* (*ὀστάριον*, ossicle, *φύση*, air-bladder), those Teleosts which possess a Weberian apparatus. It is certainly convenient to have a classificatory term to indicate the community of descent of the forms so characterized.

Before proceeding to examine the condition of the parts in question in Hypophthalmus it may be convenient to recall that which obtains in Amiurus, where the apparatus is probably as fully developed as in any of the Nematognathi.

The sacculi of the auditory labyrinths of both sides are connected by a transverse duct, from which there projects backward in the middle line a thin-walled sac or sinus, which is accommodated in a special fossa formed by the basi- and ex-occipitals, known as the "cavum sinûs imparis." This cavum lies immediately below the medulla oblongata, where it joins the spinal cord, and is continued backwards into two diverticula (the atria sinûs imparis) lined by dura mater, which lie right and left of a median partition on the upper surface of the body of the first vertebra. The lateral walls of the atria are formed by the stapedes, the modified neural arches of the first vertebra. Filling up the gap between each stapes and the exoccipital on each side is an intercalated piece or claustrum. The varying states of distension of the air-bladder affect the stapedes (and, consequently, the auditory labyrinth through the fluid in the atria and cavum sinûs imparis) by means of the altered transverse processes of the third vertebra—the so-called "Mallei"—which posteriorly are connected with the external tunic of the air-bladder, and anteriorly (indirectly) with the stapedes, by intermediate pieces—the incudes—which are the altered neural arches of the second vertebra. The first vertebral centrum is distinct and of con-

siderable size, while the second and third are much reduced and fused with the fourth, which is of great size, and has very large transverse processes. These roof over the anterior part of the air-bladder, and articulate anteriorly with the supraclaviculars. Although the fifth vertebra is fused in the adult with the fourth, it does not contribute to the formation of the Weberian apparatus. In determining the homologies of the osseous parts of the apparatus, the spinal nerves form excellent landmarks. Of these, the first pair (hypoglossal *auct*) emerge through the exoccipitals, the second and third in the interval between the stapedes and the arch of the third vertebra, while the fourth and fifth penetrate the arches of the third and fourth vertebræ respectively.

How far my interpretation of the homologies of the Weberian ossicles differs from the results arrived at by other authors has been already indicated in No. 11, p. 248. I shall take occasion to refer below to certain divergences between the views just expressed and those embodied in Sagemehl's paper, but I may first point out how generally the numbers of the anterior vertebræ have been misreckoned by authors dealing with the parts in question. Thus Reissner (No. 5 Fig. 9) figures as the first vertebra of *Loricaria cataphracta*, a complex, the greater bulk of which is formed of the fourth vertebra. Göldi commits the same error (No. 3, p. 414), and Weyenbergh figures (No. 8, Pl. IX. Fig. 31), as the first vertebra of *Hypostomus plecostomus*, what is unquestionably its fifth. These errors are attributable to the extreme reduction of the anterior vertebræ, which appears to be carried in some respects further than in Hypophthalmus, although the union with the occipital region is more complete in the latter. This reduction is not such in Amiurus as to affect materially the spinal nerves, but it does so in Hypophthalmus, and it is extremely probable that investigation will show that the second and third spinal nerves in the Hypostomatina are profoundly affected by the vertebral concrescence in this region. I observe in the arches of what is termed, by Reissner and Göldi, the first vertebra, two series of foramina, which I have no doubt serve for the escape of the fourth and fifth nerves.

In some respects, Sagemehl's interpretation of the homology of the Weberian ossicles differs from that adopted above. The incus, for example, is interpreted as the rib of the second vertebral segment, and the claustrum as a modified occipital arch. As I have elsewhere remarked, the Siluroids (Amiurus at least) do not afford the necessary material for determining the homology of the incus on account of its reduced condition, but its ascending process appears to me to enter into the wall of the neural canal in Catostomus, in which case it must be a modified neural arch. I have not had the opportunity of settling this definitely by examining the relationship of the third spinal nerve to that process. With respect to the homology of the claustrum, which I have been inclined to regard as a modified "tegular-stück," I shall merely observe that the additional spinal nerve issuing between the claustrum and stapes in Silurus (*cf.* Sagemehl, p. 56) is certainly quite unrepresented in Amiurus.

In Sagemehl's memoir, so frequently cited, will be found (p. 9) a synopsis of those Nematognathi which have been supposed to be destitute of an air-bladder, and, consequently, of a Weberian apparatus. Joh. Müller refers the genera Cetopsis, Arges, Brontes, Loricaria, Rhinelepis, Hypostoma, Callichthys to this category; Valenciennes adds to the list, Hypophthalmus, Bagarius, Glyptosternum, Trichomycteres, Eremophilus; Reissner

having shown the existence of a reduced Weberian apparatus in the Hypostomina, Sagemehl concludes that Arges and Brontes, the unarmoured relatives of this group, must likewise possess one. Day has demonstrated the existence of an air-bladder surrounded by bone in Bagarius and Glyptosternum ; Sagemehl, a similar condition in Trichomycteres (which is a near relative of Eremophilus), so only Cetopsis and Hypophthalmus remain, but these, after experience with the other genera, evidently require a thorough revision before one can confidently assert the absence of Weberian apparatus.

The present paper is intended to furnish the necessary revision for Hypophthalmus, which, it will be shown, does not depart from the ordinary Siluroid type in this important respect.

If the skull of Amiurus be macerated, the first vertebral centrum separates readily from the basioccipital, and the neural spine which projects forwards from the region of the third vertebra and articulates with the exoccipitals and supraoccipital spine, likewise comes away with ease. The union of the conjoined anterior vertebræ with the skull in the only Hypostome I have examined (*Liposarcus pardalis*) is more intimate, but by no means so much so as to prevent the separation of the parts by maceration, and the study of the ossific centres of the hinder region of the cranium (*cf.* Göldi, No. 3, p. 414.) But Hypophthalmus conducts itself differently in this respect, complete ankylosis of the conjoined anterior vertebræ with the skull taking place, first, between the centra- and the basi-occipital (Fig. 2), secondly, between the roof of the neural canal and the supra- and ex-occipitals (by means of perichondral bone which does not, however, obliterate the cartilaginous boundaries of the foramen magnum from the internal aspect), and thirdly (indirectly) by means of the supraclavicles, which are fused with the anterior expanded ends of the fourth transverse processes, and with the neighbouring pterotic and epiotic regions of the skull (behind *fe* in Fig. 3.) In Figs. 1 and 2, which represent the cranium from the dorsal and ventral aspects respectively, the anterior conjoined vertebræ are represented in their natural connection with the skull, the sixth, seventh, and eighth (free) vertebræ being also included, to indicate the contrast between these and the conjoined vertebræ. The posterior limit of the skull bounded by the supraoccipital and epiotics is sufficiently distinct on the dorsal aspect, much less so on the ventral where the supraclavicles, sending their medial processes towards the basioccipital, tend to conceal the hinder wall of the skull. As observed above, complete osseous union takes place between the supraoccipital spine and the neural spines of the conjoined vertebræ. The supraoccipital spine itself is deeply grooved on its dorsal aspect as far forwards as the cranial fontanelle. A ridge is readily observed continuing the epiotico-pterotic suture on to the dorsal surface of the supraoccipital, and marking off an anterior part on each side, sculptured like the frontals, and a posterior part which serves for the attachment of part of the dorsal musculature. The former correspond to the parietals which in the Nematognathi are confluent with the supraoccipital (Cope, No. 1, p. 330.) From the figures it will be observed that the complex supraoccipital articulates with the exoccipitals, epiotics, pterotics, sphenotics, and frontals. Only a partial study of the other bones of the occipital segment can be made from Fig. 2. As in all the Nematognathi I have examined, the basioccipital articulates with processes of the supraclavicles, which in this case project obliquely forwards towards it, while their direction in other cases is transverse. Right and left of the basioccipital appear the exoccipitals, the form of which will be gathered more readily from the sections

to be afterwards described. The exoccipitals, besides forming a considerable part of the floor of the skull (where they are perforated by the glossopharyngei), likewise contribute to the formation of the hinder wall and sides. Instead of the foramen for the vagus being in the floor as in Amiurus, it is in a large fenestra on the hinder wall, which is bounded medially by a slender bony style, through which the first spinal (occipital) nerve escapes, and which simultaneously forms the antero-lateral boundary of the saccus paravertebralis, through which the malleus reaches the interior of the cranial cavity. The epiotics are entirely, and the pterotics partially, excluded from appearing in the inner aspect of the brain case by the exoccipitals.

Entering into the composition of the auditory capsule are the prootic, epiotic, pterotic, and sphenotic. The two latter chiefly appear on the side walls of the skull, and are grooved by the fossa for the hyomandibular, while the prootic is confined to the floor, and the epiotic to the outer aspect of the roof. The hyomandibular and palatine branches of the seventh nerve pierce the prootic, which likewise contributes to the formation of the trigeminal foramen.

There is no opisthotic. Both pterotics and sphenotics are largely formed round the neuromastic (sensory) canals, which are continued forwards in these bones from the supraclavicles Although the medial borders of the prootics are in contact with each other in the floor of the skull for their posterior halves (being there covered by the parasphenoid), they are separated in front by a backward projection of the basisphenoid, between which and the basioccipital a considerable amount of cartilage persists in the adult skull. The basisphenoid and alisphenoids contribute with the prootics to the formation of the trigeminal foramen, and the former, as in all the Nematognathi I have examined, is fused with the parasphenoid, and comes away with the latter in the disarticulated skull. Between the basi- and ali-sphenoid on each side is the small foramen for the optic nerve.

The alisphenoids are only visible on the floor of the skull, they form with the sphenotics the posterior boundaries of the orbits and in addition to articulating with the basisphenoid and sphenotics, form the chief surface of union between the unpaired orbitosphenoid and the middle region of the skull.

Covering the orbitosphenoid in the middle line is the anterior half of the parasphenoid, which lies in a groove on the under surface of the former, and is readily detached from it by maceration. The parasphenoid presents similar features to the same bone in Liposarcus (Hypostomidæ), and it appears to me probable that both it and the vomer occur in all the members of that family, and that Göldi overlooked them in Loricaria on account of their slenderness.

Only a very small portion of the orbitosphenoid appears on the upper surface of the skull, and this part is exposed by the divergence anteriorly of the frontals, which are in contact (by a deeper lamella of thin osseous substance) from the cranial fontanelle already referred to, as far as another and smaller fontanelle which corresponds to the foremost part of the cranial cavity, and is to be seen directly behind the orbitosphenoid in Fig. 1.

The frontals are sculptured on the greater part of their upper surface; they form ledges overhanging the orbits, and articulate with the orbitosphenoid for only a small extent, in front of which a slit (indicated in Fig. 2) separates the two bones.

In front of the orbitosphenoid and frontal are the parethmoids, which for part of their upper surface partake of the sculpturing of the frontals. They are in contact with each

other (except for a persistent median strip of cartilage) in the middle line, and carry as usual on their ventral aspects the fossæ for the articulation of the palatine arch.

A slender vomer invests the strip of cartilage referred to from below, and extends forward towards the middle of the papyraceous mesethmoid, which forms a considerable part of the thin vaulted roof of the mouth of this remarkable genus. The mesethmoid is separated from the parethmoid by persistent strips of cartilage, and is intimately united with the premaxillaries which are coalesced in the middle line, are destitute of teeth, and partake of the papyraceous texture of the mesethmoid. Right and left of the premaxillaries are the maxillaries, slender rods which support the long maxillary barbels. On the upper surface of the skull two further bones are met with, both slender and in contact with the sculptured face of the parethmoid. These are the nasal and antorbital which shelter the foremost divisions of the neuromastic canals of the head, and are situated on the lateral and mesal aspects of each nasal sac. The neuromastic canals enter them from the parethmoid, the sculptured face of which is consequently to be regarded as developed round these canals.

From Figs. 1, 2 and 3 some facts may be gleaned as to the form of the conjoined anterior vertebræ and the supraclavicles. In certain Nematognathi (the Hypostomidæ) the fifth vertebra has two kinds of transverse processes, one projecting outward from the junction of neural arch and neural spine, the other from the centrum; both unite laterally into a single plate. The fourth transverse process in Hypophthalmus is somewhat similarly formed; it has a dorsal and a ventral lamella, which are continued backward and laterally into a single plate, leaving between them a cavity in which lies the rudimentary air-bladder. (Fig. 3). The lateral border of the dorsal lamella is quite sharp, and is coossified with the epiotic process of the supraclavicle. At the junction of the dorsal lamella with the arch are to be seen the foramina for the dorsal divisions of the fourth and fifth spinal nerves, and these foramina serve to indicate the posterior limit of the third and fourth neural arches respectively. The ventral lamella only abuts against the body of the vertebra by a slender process (seen directly behind the basioccipital process of the supraclavicle in Fig. 2), but is continuous behind with the more massive transverse process of the fifth vertebra. Against the plate projecting backward from the union of the dorsal and ventral lamellæ, the main part of the supraclavicle is applied like a splint: the lateral neuromastic canal enters the interval between these before becoming entirely surrounded by the supraclavicle, and a fossa for the articulation of the shoulder girdle is left between the point of the plate referred to, and the postero-lateral angle of the supraclavicle. A similar fossa is found both in Amiurus and Aspredo, but in Liposarcus the supraclavicle alone comes into relationship with the shoulder girdle.

I have already drawn attention to the union of the supraclavicle with the skull; the union is sutural only with the basioccipital, but the epiotic and pterotic processes are completely fused with those regions of the skull. Between these two is an aperture in the dried skull, which will be seen from Figs. 11 and 12 (which pass through it) to be utilized for sending off important cutaneous branches from the neuromastic canal. If a bristle be passed into this aperture in the macerated skull towards the hinder surface of the exoccipital, it can readily be caused to enter the cranial cavity through the large fenestration through which the vagus escapes.

Fig. 4 represents the opercular apparatus and jaws from the lateral aspect. The

operculum is of large size, the interoperculum very small, and the suboperculum, as usual, absent. The preoperculum is fused with the hyomandibular and quadrate, but a cartilaginous strip persists between the quadrate and the hyomandibular. Part of the arch dorsal to the quadrate is probably the metapterygoid, but there is no suture to indicate its separateness from the hyomandibular. The palatine contrasts markedly in shape with the rod-like palatine of Amiurus; some cartilage persists at the articular knob which rests in the fossa on the parethmoid. The edentulous dentary is of small size, the articular element, on the other hand, is large; but no others are to be detected in the adult.

Although foreign to my present purpose, I have figured the singular shape of the shoulder-girdle (Fig. 5.) the clavicles being prolonged as far as the symphysis of the lower jaw.

The series of selected sections, represented in Figs. 6–16, was made from one of the specimens at my disposal, with the view of elucidating those relationships of the auditory organ to the air-bladder, which it would have been impossible to arrive at satisfactorily, even with the most careful dissection of a single specimen. The series extended from behind the trigeminal foramen to the plane of emergence of the sixth spinal nerve, and included over 300 sections.

Fig. 6 represents one of the foremost of these; it passes through the posterior cranial fontanelle, the supraoccipital (parietal element), sphenotic, prootic, basisphenoid (and parasphenoid). Some cartilage persists between the supraoccipital and sphenotic and in the sphenotico-prootic suture. The brain is evidently similar to that of Amiurus (*cf.* my Fig. 10, Pl. V, *loc. cit.*). From the facio-trigeminal ganglion there is given off a branch to the neuromastic canal in the sphenotic, which I have identified as the ramus oticus in Amiurus (No. 9, p. 366) and Lepidosteus (No. 10, p. 490). In the skin overlying the sphenotic are branches of the neuromastic canal, which, however, do not contain neuromasts, but are the complex channels by which the canal puts itself in communication with the outside. Solger has referred to this method of the opening of the neuromastic canals in the genus at present under consideration (No. 7, p. 372).

Fig. 7 hardly requires a separate description; it falls through the plane of escape of the hyomandibular and palatine branches of the facial, and indicates how the prootic and sphenotic participate in the formation of the fossa which conceals the anterior bend of the anterior semicircular canal. Although all the bones of the skull are fragile, this is especially true of those of the roof, which have an extremely spongy texture, the intervals between the delicate osseous trabeculæ being occupied largely by fat cells.

The section represented in Fig. 8 falls through the plane of the sphenotico-pterotic suture, where a considerable amount of cartilage persists, and even enters into the formation of the hyomandibular fossa. It will be seen that the neuromastic canal lies directly on the surface of the cartilage, or is separated therefrom only by a very delicate lamina of bone. As one would expect from the great development of the system of neuromastic canals in this fish, the tuberculum acusticum, that region of the brain in which the dorsal branches of the various cranial nerves centre, is of unusual dimensions.

Our next section (Fig. 9) is entirely behind the prootic, and thus at a considerable interval from the last. It falls through the plane of the utriculus proper, and near the ductus sacculo-utricularis, which effects the communication between the upper and lower

parts of the labyrinth. It is entirely behind the anterior branch of the auditory nerve, which is, as usual, chiefly distributed to the macula recessûs utriculi, but shows the relation of the saccular and lagenar branches of that nerve in their backward course. The relationship of the trigeminal lobe of the medulla oblongata to the utriculus is somewhat peculiar. On account of the large size of the former it projects backward laterad of the utriculus, which, accordingly, does not lie close against the skull, as is usual in the Teleostei. Worthy of note is the relative size of the osseous and external semicircular canal in the pterotic, and the neuromastic canal in the same bone. This section falls behind the parietal part of the supraoccipital, and, consequently, through the grooved spine, and that part which serves for the attachment of the dorsal musculature, and for the shelter of the anterior part of the posterior semicircular canal.

Fig. 10 represents a section immediately behind the foramen for the glossopharyngeus ; the position of that foramen being indicated by an arrow on the left side of the figure. The exoccipital is pierced in this plane by a small branch of the glossopharyngeus, which accompanies the ramus ampullæ posterioris, and is undoubtedly a dorsal branch, as it is distributed to the neuromast in the pterotic. I found no dorsal branch of the glossopharyngeus in Amiurus, and the position of escape and course of this is sufficiently remarkable.

In the skull in this region we find cartilage persisting between all of the bones, viz., the supraoccipital, exoccipital, epiotic, pterotic, and basioccipital. The form and relations of the exoccipital can be better studied from this and the following sections than from the figures of the skull. Applied against the pterotic is the most anterior part of the supraclavicle, the architecture of the osseous trabeculæ of which exhibits a striking contrast to the pterotic with which it is fused. The neuromastic canal now lies against the pterotic cartilage, and is protected on the outside by the supraclavicle.

Certain interesting points are observable in this section with regard to the auditory labyrinth. The transverse duct connecting the sacculi of both sides is met, and the wall of the duct is attached to a crest on the basioccipital, as is also the case in Amiurus (Fig. 8, Pl. VI, *loc. cit.*), from which it will also be seen that the relations of the lagenar and saccular nerves to the labyrinth are similar in both genera.

Between the ampulla of the posterior semicircular canal and the lagena cochleæ the exoccipital sends in a process, which further back (Fig. 11) forms a complete roof for the fovea for the inferior part of the labyrinth.

Important differences are to be noted in Fig. 11, which falls through the plane of escape of the vagus. In the first place the cavum sinûs imparis is observed to have its floor formed by the basi- and ex-occipitals, while its lateral walls are formed by the stapedes and its roof by an ossified plate of dura mater entirely unconnected with the exoccipitals. How different this is in Amiurus may be seen by reference to Figs. 4, 5, 6, 7, Pl. VI, *loc. cit.* Here the stapedes come chiefly in relation to the cavum sinûs imparis, there chiefly in relation to the atria sinûs imparis. The explanation of this remarkable difference is to be sought for in the fact that the greater part of the Weberian apparatus has been pushed (in the process of its reduction) into the foramen magnum, instead of being entirely outside the skull, so that we shall find in Fig. 14, which represents a section passing through the third pair of spinal nerves, that also the basioccipital, exoccipital, and epiotic bones are met with ! We shall see that the three anterior centra, with the

structures which they carry, have been telescoped, as it were, on to the upper surface of the basioccipital, and are thus partly to be met with within the foramen magnum.

As Fig. 12 represents a section falling through the plane where the first spinal nerve pierces the style-like process of the exoccipital, it will be recognized that we are still within the cranial cavity. The incus is to be seen on each side intervening between the anterior end of the malleus and the spoon-bowl shaped process of the stapes. Although the sacculi are still to be met with behind this plane, this is the last section in which the lagenæ cochleæ occur.

It will be recognized that the fenestration through which the vagus escapes is widely in communication at this point with the fossa lodging the posterior semicircular canal, and that behind this level the two main branches of the vagus, the ramus lateralis and the main trunk, diverge (Figs. 13 and 14), the one to reach the upper surface of the fourth transverse process (Figs. 15 and 16), the other to be distributed to the gill arches and the intestine. The ramus lateralis escapes first into the interval between the epiotic and exoccipital, an interval which can be traced also further forward (Figs. 11 and 10), and into which part of the dorsal musculature is continued. In Figs. 11 and 12, are seen some of the great cutaneous branches which come off from the neuromastic canal in the interval between the pterotic and epiotic processes of the supraclavicles, and in the roof of the foramen magnum the persistent cartilage already referred to, which intervenes between the supraoccipital and the roof of the neural canal. Above the cartilage is the suture which indicates the overlapping of the neural spine on the supraoccipital, which spine is developed in Amiurus from the region of the third vertebra.

Six sections intervene between the escape of the first spinal nerve and that of the second. I have only been able to find the ventral root of the latter, a circumstance which I am inclined to explain by the reduction of the vertebral segments concerned. This root escapes outward through the saccus paravertebralis which, in consequence of the forward dislocation of the part concerned, rests chiefly on the upper surface of the exoccipital. (Figs. 13 and 14.) An important difference is to be noted in Fig. 13, the section represented in which falls through the hinder part of the spoon-shaped process of the stapes. This comes in relation to the atrium sinûs imparis which is constituted by the median partition of dura mater attached to the upper surface of the centrum of the first vertebra. The mode in which this centrum has been wedged in between the ex- and over the basioccipitals is very singular, but persistent cartilage indicates the separation. The median partition of dura mater also forms the floor and part of the lateral walls of the neural canal. It is simply the unossified backward continuation of the ossified roof of the cavum sinûs imparis, and a rudimentary claustrum is to be found in it on each side in front of the level of the ventral root of the second nerve.

In this section is likewise seen a small branch of the ramus lateralis vagi which enters the slit between the supraclavicle and epiotic, descends forwards between these (r′ X.), and eventually reaches a neuromast in the supraclavicle. Fig. 13 is the foremost of the sections represented, in which the basioccipital processes of the supraclavicle appear.

Seven sections intervene between the escape of the second nerve and that of the third (Fig. 14) which, however, has both dorsal and ventral roots developed, both of which escape through the membranous walls of the neural canal. Between the centrum of the

conjoined vertebræ and the basioccipital, a piece of notochord is to be seen, and resting on the surface of the centrum, are the articular processes (largely cartilaginous) of the stapedes and the remains of the median partition of dura mater. This must, consequently, still be the upper surface of the first centrum.

Although the fovea for the sacculi is not entirely absent in the next section represented (Fig. 15, between which and Fig. 14 twelve sections intervene), yet it is obviously in the region of the third vertebral centrum, for it passes through the points of attachment of the mallei to the centrum, and through the escape of the dorsal and ventral divisions of the fourth nerve through the well-developed third neural arch, but in the following figure from the thirtieth section further back (Fig. 16), the large centrum of the fourth vertebra is reached, and there is no trace of any backward prolongation of the basi- and ex-occipitals. Here the dorsal and ventral lamellæ of the transverse process may be studied (t^2 4 and t' 4,) and their relationship to the supraclavicle. It will be seen that the lateral neuromastic canal, although protected on the outside by the supraclavicle, is not surrounded by bone on its medial aspect, but lies free in the interval between the two lamellæ of the transverse process referred to.

A comparison of the number of sections between the emergence of the spinal nerve will be instructive, not only in enabling us to arrive at a conception of the great development of the fourth vertebra, but of the remarkable reduction affecting those in front of it. Thus thirty-six sections intervene between the escape of the fifth and sixth nerves, that is to say, between the hinder parts of the arch of the fourth vertebra and that of the fifth.

This would, probably, be the average between similar points of succeeding vertebræ, but 70 sections intervene between the fifth and fourth nerves, 12 between the fourth and third, 7 between the third and second, and 6 between the second and first.

Some further points of interest are to be studied in Fig. 16, which represents a section nearer the anterior than the posterior end of the fourth vertebra. This section falls through the rudimentary air-bladders which lie on each side between the dorsal and ventral lamellæ of the transverse processes. Part of the bladder (ab^1) is membranous, part (ab^2) is osseous. The latter is continuous with the body and arches of the vertebra, and its presence has profoundly modified the shape of the neural canal, and, consequently, of the spinal cord in this region. A communication between the hinder end of the malleus and the membranous portion of the bladder can still be traced in front of this plane. The figure represents only the tunica externa, and it will be observed that the osseous portion is evidently formed by ossification of the tunica externa and subsequent fusion with the walls of the neural canals. A similar ossification of a very small part of the tunica externa in Amiurus, gives rise to the sickle-shaped process of bone resting on the side of the fourth vertebra, and continuous in the adult with the malleus. No communication can be detected between the two rudimentary air-bladders, nor any between the internal tunics and the œsophagus.

From the above description it becomes apparent that while the air-bladder and Weberian apparatus of Hypophthalmus are certainly anomalous, yet they are constructed upon precisely the same type as those of the other Nematognathi. Their reduced and functionless condition is probably not more pronounced than in many Hypostomidæ, but some further investigations on the latter are desirable before an attempt is made to

settle definitely the relations of Hypophthalmus to that family. It is evident from the researches of Reissner, that considerable limits exist as to the development of the air-bladder and Weberian apparatus in the Hypostomes (*cf.* Rhinelepis and Loricaria). I hope in some future studies on the Siluroids, to call further attention to the remarkable modifications which the skull and anterior vertebræ undergo in the group.

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DESCRIPTION OF PLATES VIII, IX, and X.

All the figures are illustrative of *Hypophthalmus marginatus*.

Fig. 1.—Cranium and anterior vertebræ from above slightly enlarged.
Fig. 2.—The same from below.
Fig. 3.—Side view of posterior end of cranium and anterior vertebræ.
Fig. 4.—Opercular apparatus and jaws from the lateral aspect.
Fig. 5.—Shoulder-girdle from above.
Fig. 6–16.—Selected sections from a series of over 300, extending from shortly behind the trigeminal foramen to behind the foramina of the 6th spinal nerve.

Of these Sections, Fig. 6 represents the 19th, 7 the 30th, 8 the 43rd, 9 the 126th, 10 the 142nd, 11 the 155th, 12 the 162nd, 13 the 168th, 14 the 175th, 15 the 187th, 16 the 217th; while the 5th spinal nerve escapes in the 257th, and the 6th in the 293rd.

The enlargement is about 8 diam. lin.

LIST OF LETTERING EMPLOYED IN THE PLATES.

a — atrium sinûs imparis.
aasc — ampulla of anterior semicircular canal.
ab — air-bladder, ab^1 ab^2, its membranous and osseous portions.
an — antorbital.
apsc — ampulla of posterior semicircular canal.
art — articulare.
as — alisphenoid.
asc — anterior semicircular canal.
bo — basioccipital.
bs — basisphenoid.
c^1 — centrum of 1st vertebra.
ca^1 — cartilage persisting between sphenotic and pterotic.
ca^2 — cartilage persisting between supraoccipital and osseous roof of neural canal.
cbl — cerebellum.
csi — cavum sinûs imparis.
d — dentary.
dm — dorsal musculature.
dts — transverse duct connecting the sacculi.
eo — exoccipital.
epo — epiotic.
esc — external semicircular canal.
f — frontal.
fe — fenestra between epiotic and pterotic processes of the supraclavicular.
fp — fossa on the parethmoid for the palatine.
fs — fovea sacculi.
fsh — fossa for articulation of shoulder-girdle.
g V — ganglion of the trigeminal complex.
hmd — hyomandibular.

hmf	fossa for the hyomandibular.
hyp	hypophysis cerebri.
i	incus.
iop	interoperculum.
la	lagena cochleæ.
li	lobus inferior cerebri.
lop	lobus opticus.
lt	lobus trigemini.
m	malleus.
md	medulla oblongata.
me	mesethmoid.
mx	maxilla.
na	nasal.
nc	notochord.
nmc	neuromastic (nervenhügel) canals.
op	operculum.
os	orbitosphenoid.
pal	palatine.
pe	parethmoid.
pmx	premaxilla.
pro	prootic.
ps	parasphenoid.
psc	posterior semicircular canal.
pto	pterotic.
qu	quadrate.
r′ X	branch of the Ramus lateralis vagi distributed to the neuromast in the supraclavicular.
rd IX	dorsal branch of the glossopharyngeus distributed to neuromast in the pterotic.
rh VII	hyomandibular branch of the seventh.
r la	ramus lagenæ cochleæ.
r la X	ramus lateralis vagi.
r ot VII	ramus oticus of Facio-trigeminal ganglion.
r p VII	palatine branch of seventh.
r sa	ramus sacculi.
s	stapes.
sa	sacculus.
scl	supraclavicular; $scl^{1\,2\,3}$, the occipital, pterotic, and epiotic processes, respectively.
so	supraoccipital.
sp	saccus paravertebralis.
spo	sphenotic.
ss	supraoccipital spine.
su	suture between the 4th and 5th vertebral centra.
sv	saccus vasculosus.
$t^1 4\ t^2 4$	dorsal and ventral elements of the 4th transverse process.
ta	tuberculum acusticum.
tc	tuber cinereum.
ut	utriculus.
v	vomer.
val	valvula cerebelli.

Roman numerals indicate cranial nerves or their foramina; Arabic, similarly, spinal nerves.

NOTES AND CORRECTIONS.

SECTION III. No. 6.

Dr. T. Sterry Hunt. *On a Natural System in Mineralogy; with a Classification of Native Silicates.*

A Supplement to this paper will be printed in the next volume of the Transactions, and will embody the corrections and additions which appear in the Author's "Mineral Physiology and Physiography," (Boston, 1886.)

SECTION IV. No. 1.

Sir Wm. Dawson. *On the Mesozoic Floras of the Rocky Mountain Region of Canada.*

1. The stream referred to as the "Middle Branch, North Fork, Old Man River" is the same as that elsewhere in the paper styled the "N. W. Branch of the North Fork, Old Man River."

2. The initials of Mr. Tyrrell of the Geological Survey, given as "R. B.", should be "J. B."

3. On page 19, line 1, and in the note on page 20, the thickness of the Fort Pierre and Fox Hill groups is stated as being 1,700 feet. The thickness of these formations in the district in question does not exceed 800 feet, though, with respect to the horizon of fossil plants referred to, 400 feet may be added to this for the Upper part of the Belly River beds.

4. The species *Abietites Tyrrellii* belongs to the Fort Pierre and not to the Laramie.

5. A recent letter, from Prof. W. M. Fontaine of Virginia College, informs me that he is now studying, and will shortly publish, a Lower Cretaceous Flora from Virginia which may possibly be as old as the Kootanie beds. He also states that he has reason to believe that some of the leaves usually referred to Podozamites belonged to broad-leaved conifers. I think it likely that those I have described are really cycadaceous; but in some of the beds there are great numbers of detached leaflets resembling Podozamites, and which may have been derived from coniferous trees.

It is to be observed that, in the above paper, the author does not deal specially with the questions raised by the Laramie Flora, which he regards as a transition group between the Cretaceous and the Tertiary, the same ground which he occupied on this subject in 1875. Additional material is however accumulating, and it is hoped that the whole Laramie flora, so far as known, may be dealt with in the course of this year. In the meantime it seems not improbable that if a line of separation can be drawn between the flora of the Upper Cretaceous and the Eocene, it may pass through the Willow Creek series in the middle of the Laramie.

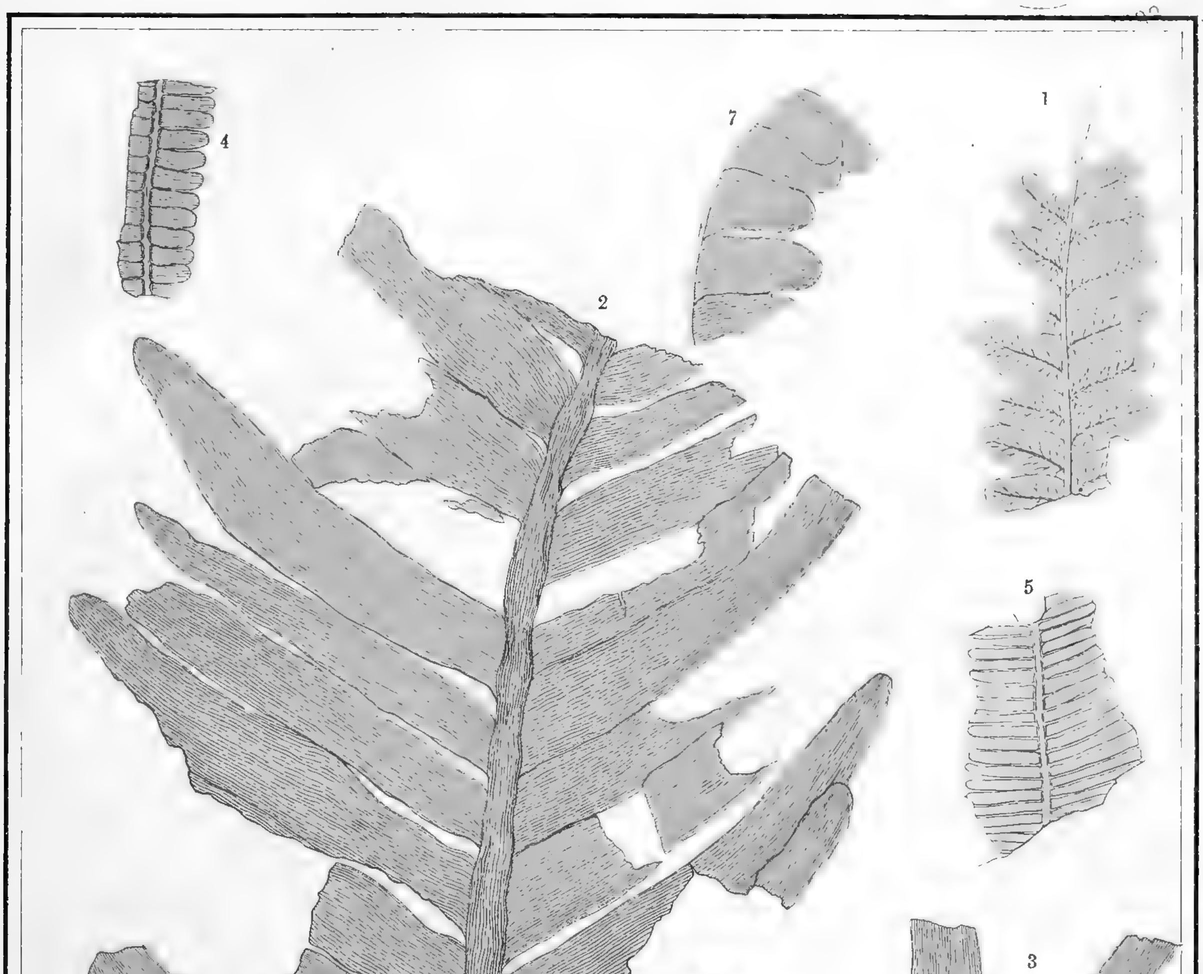


Fig. 1. Asplenium Martinianum. Fig. 2. Dioonites borealis. Fig. 3. Podozamites lanceolatus.
Fig. 4. Zamites, Sp. Fig. 5. Zamites acutipennis. Figs. 6, 6a. Zamites Montana.
Fig. 7. Anomozamites acutiloba.

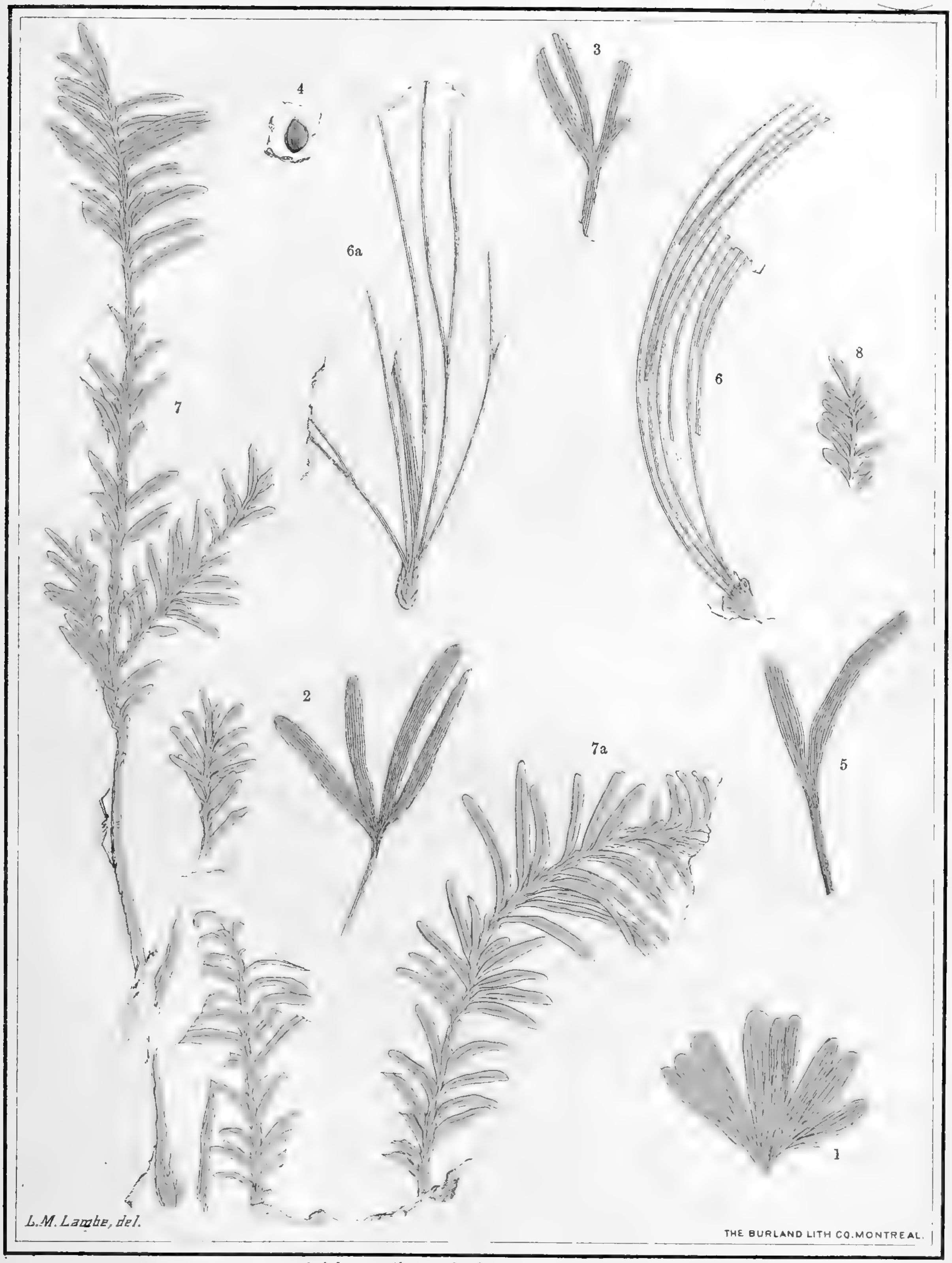


Fig. 1. Salisburia Sibirica. Fig. 2. Salisburia lepida. Fig. 3. Salisburia nana.
Fig. 4. Nutlet of Salisburia. Fig. 5. Baiera longifolia. Figs. 6, 6a. Pinus Suskwaensis.
Figs. 7, 7a. Sequoia Smittiana. Fig. 8. Taxodium cuneatum.

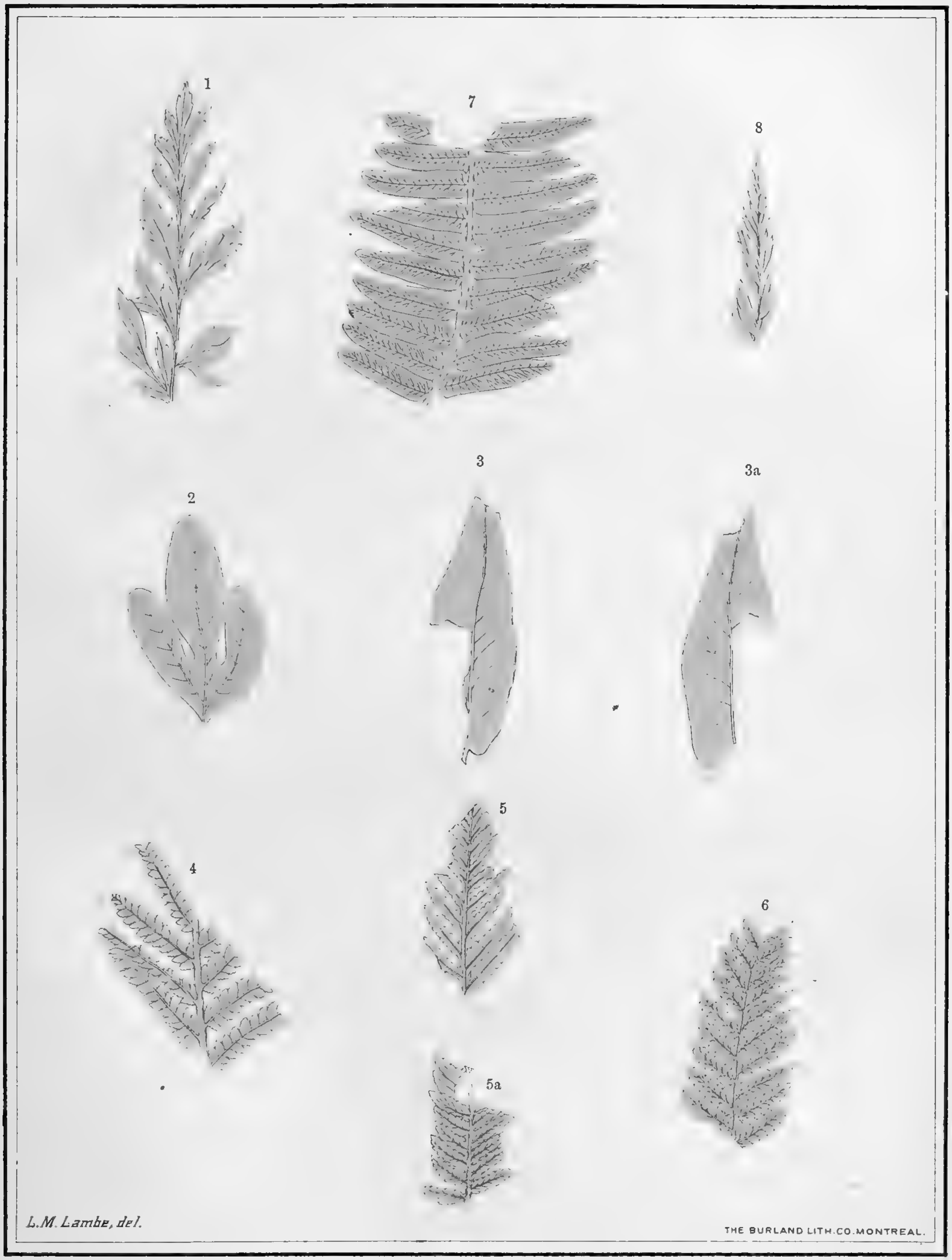


Fig. 1. Asplenium Dicksonianum. Fig. 2. Sterculia vetustula. Figs. 3, 3a. Laurus crassinervis. Fig. 4. Gleichenia gracilis. Figs. 5, 5a. Dicksonia munda. Fig. 6. Asplenium Albertum. Fig. 7. Asplenium distans. Fig. 8. Glyptostrobus Groenlandicus.

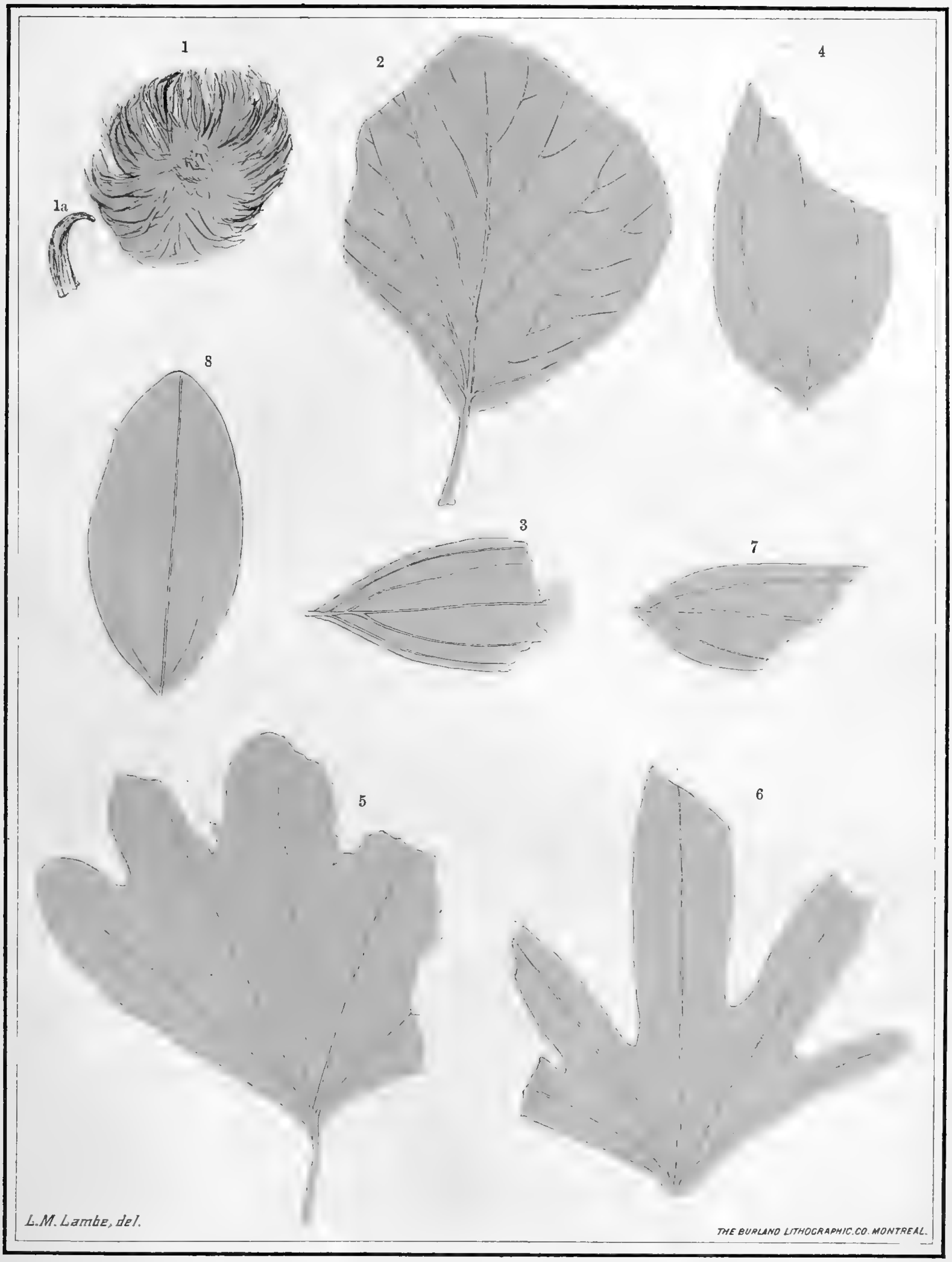
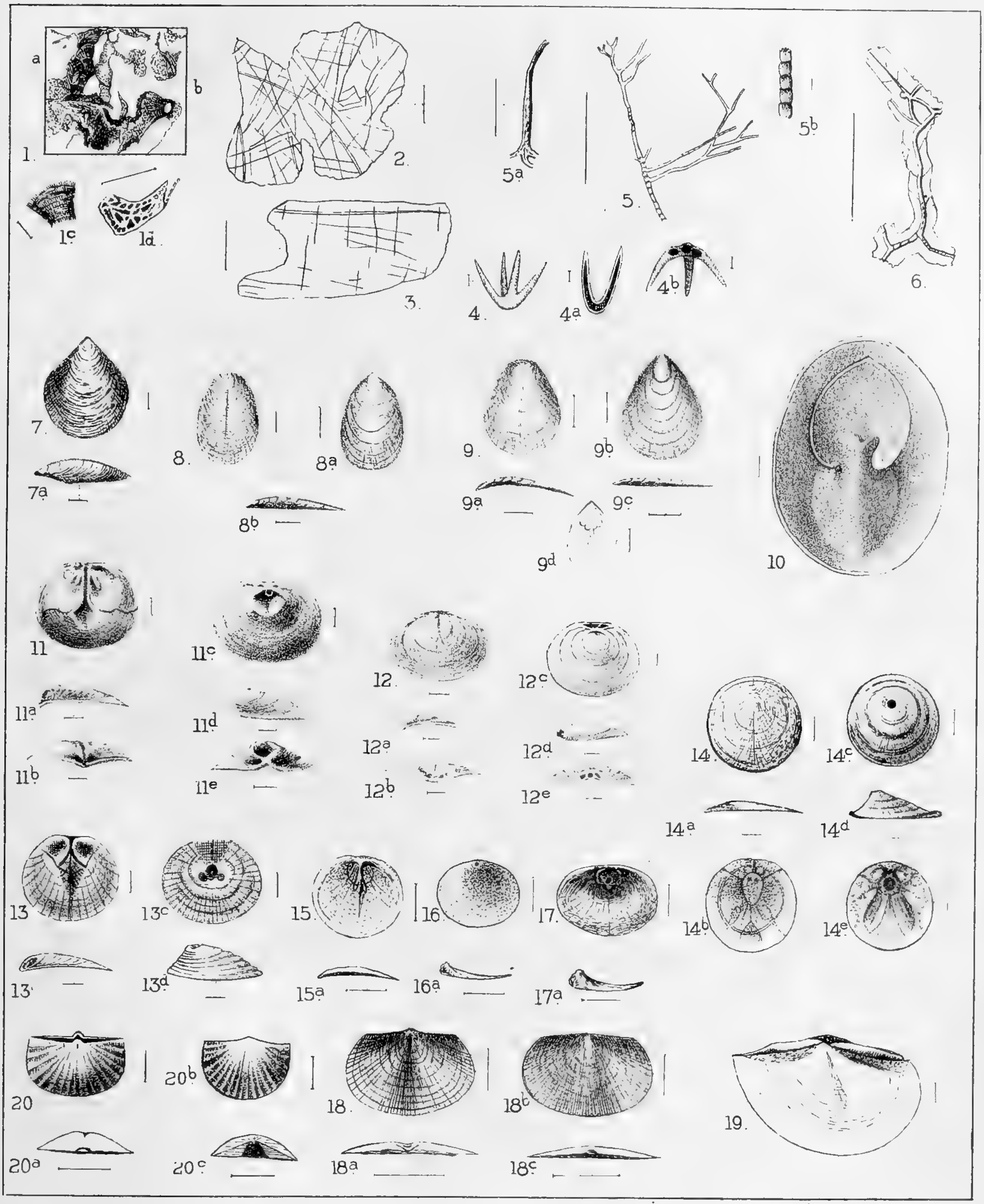
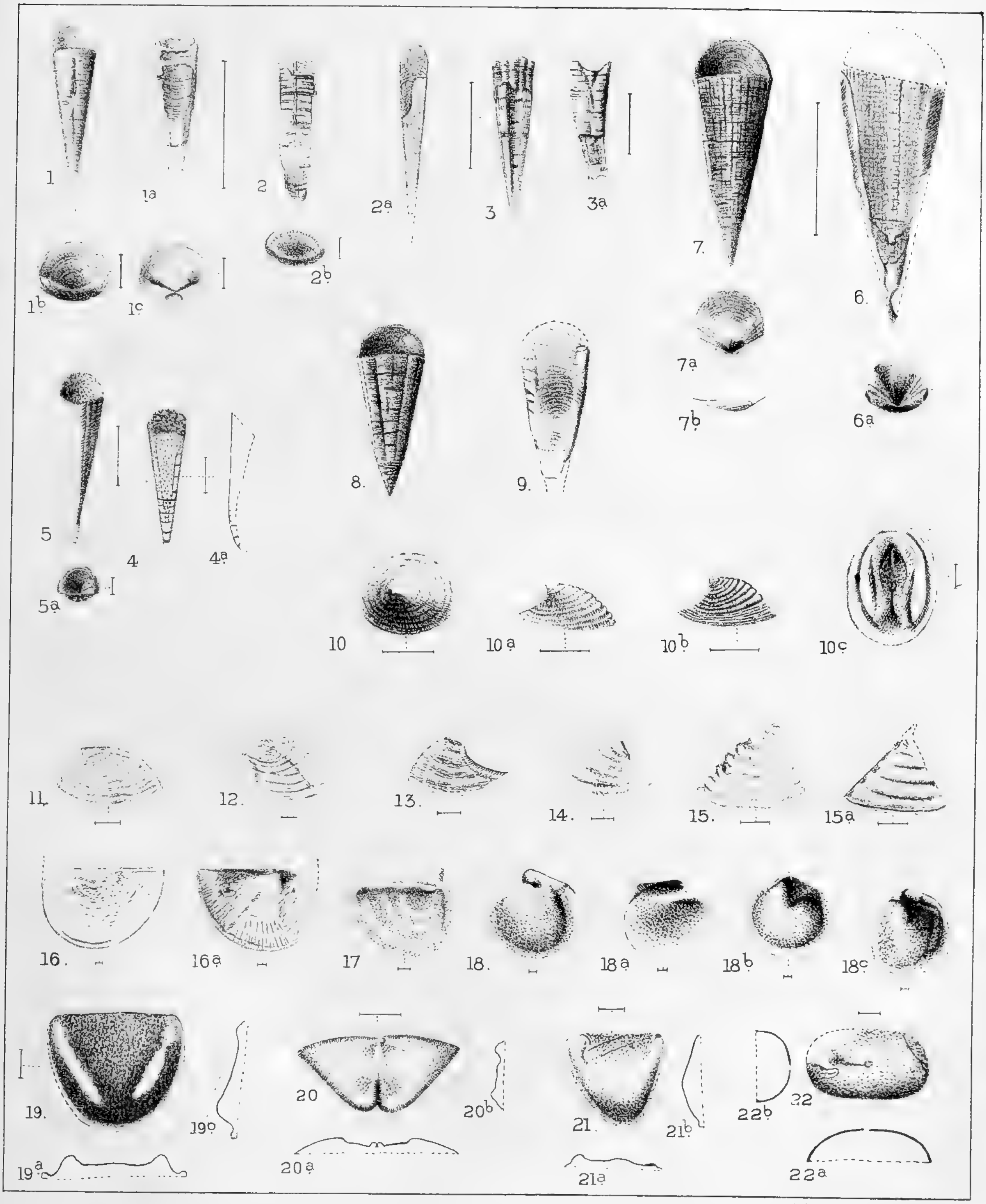


Fig. 1. Williamsonia recentior. Fig. 2. Platanus affinis. Fig. 3. Macclintockia cretacea.
Fig. 4. Paliurus ovalis. Fig. 5. Aralia rotundata. Fig. 6. Aralia Westoni.
Fig. 7. Cinnamomum Canadense. Fig. 8. Paliurus ovalis.



To illustrate Mr. G. F. Matthew's Paper on the Fauna of the St. John Group.



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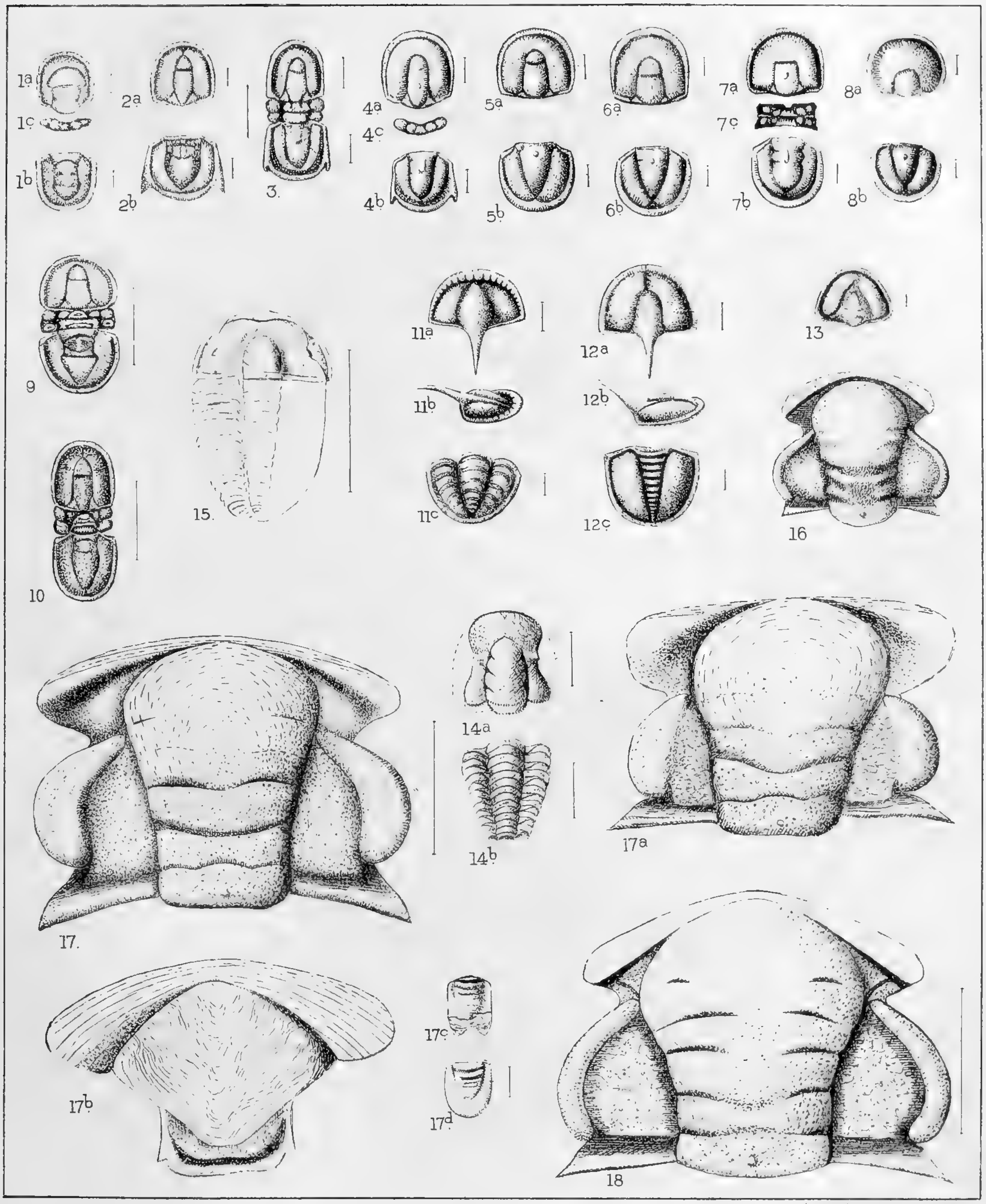

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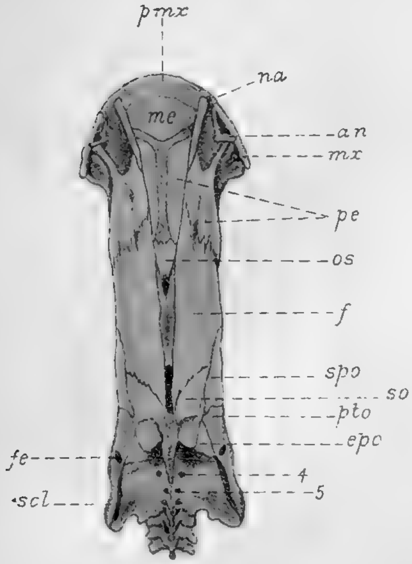

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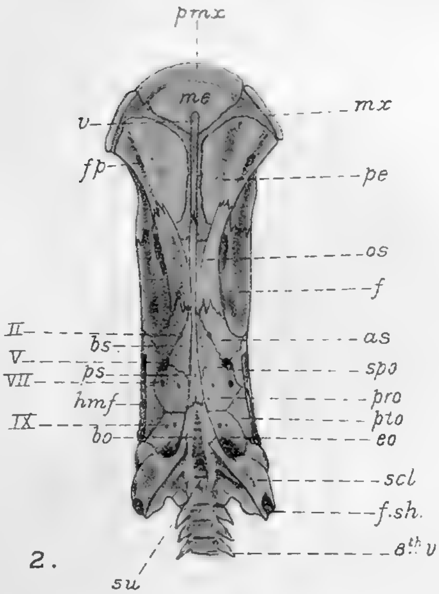

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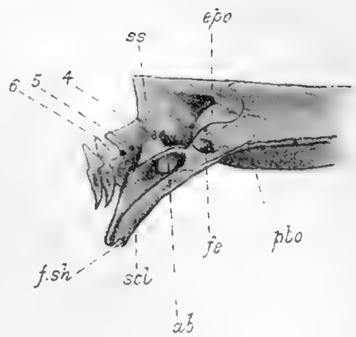

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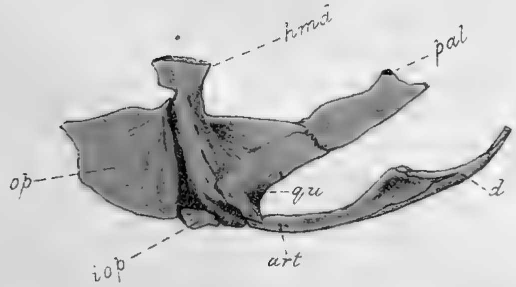

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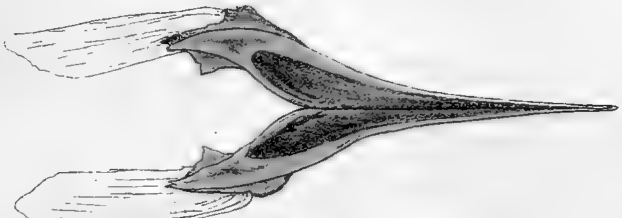

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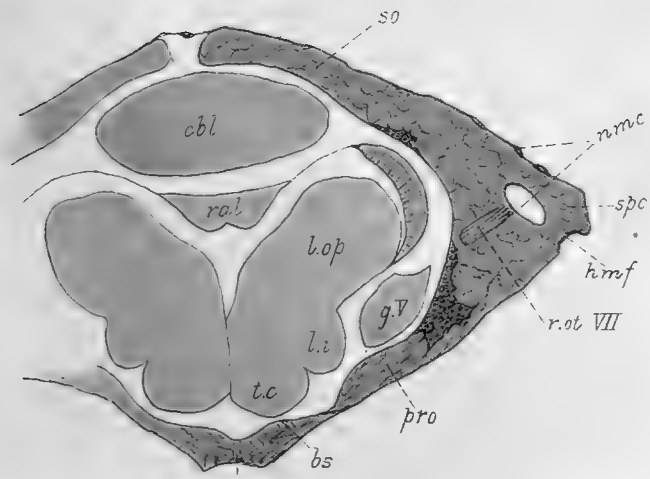

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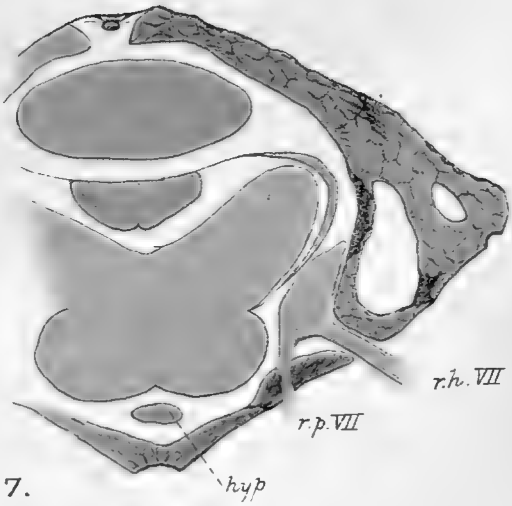

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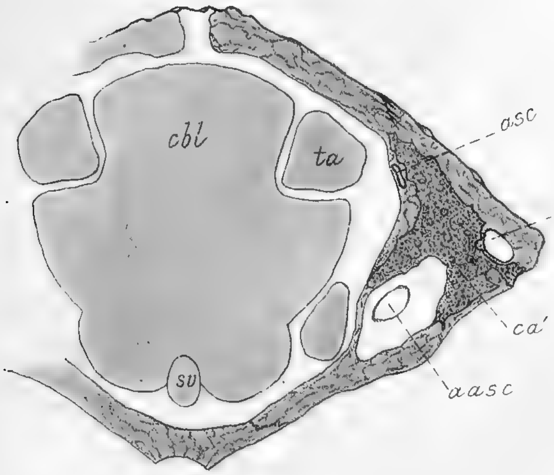

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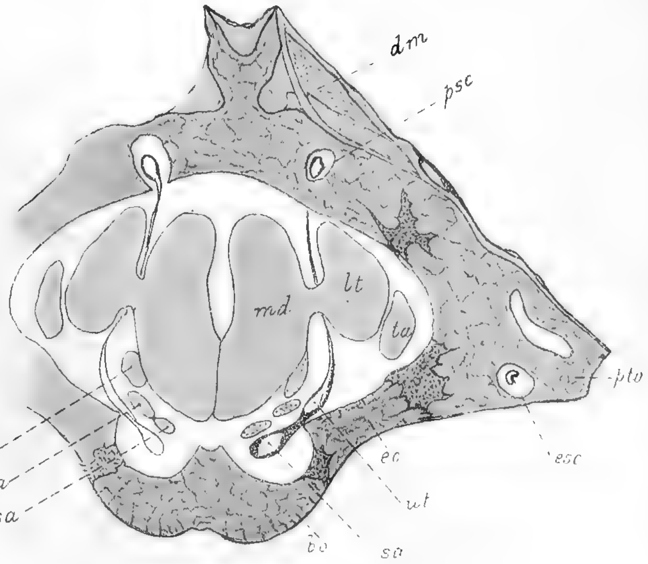

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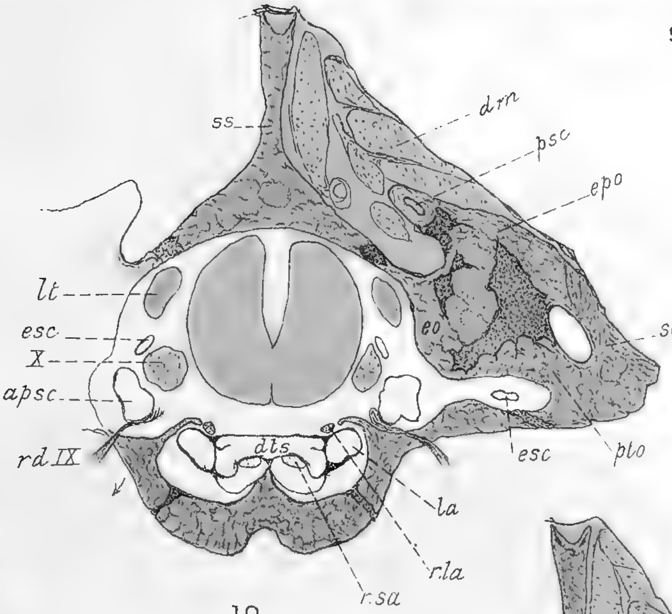

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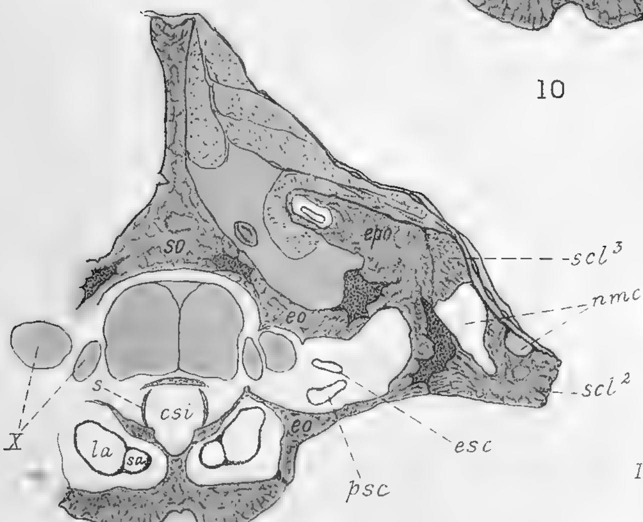

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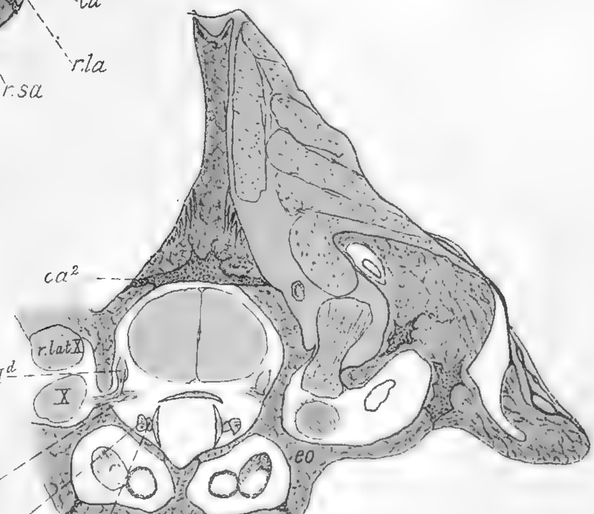

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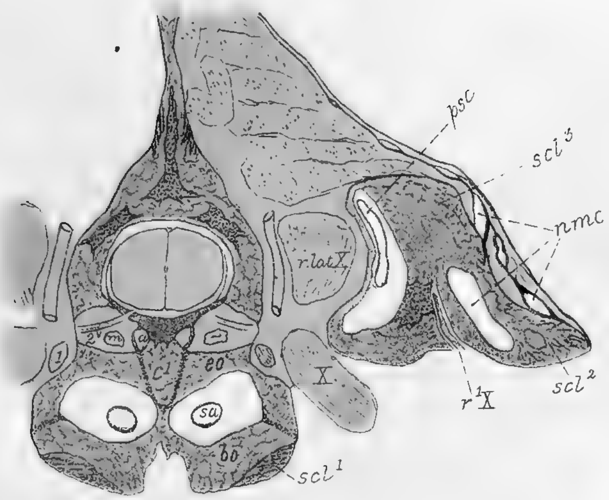

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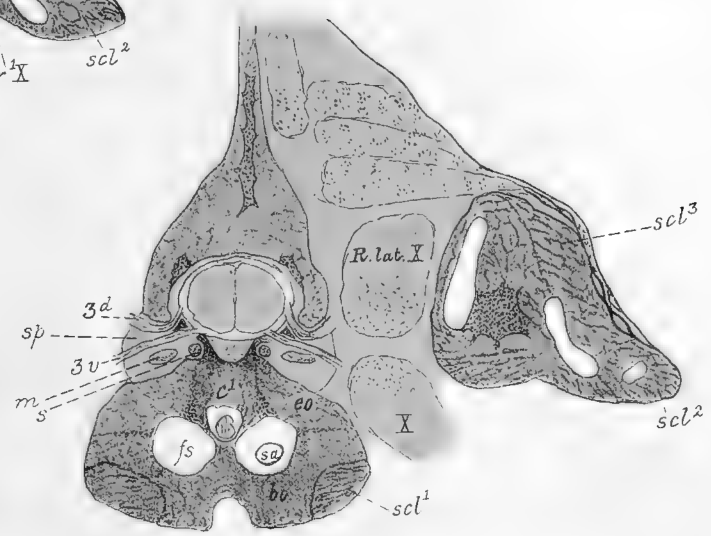

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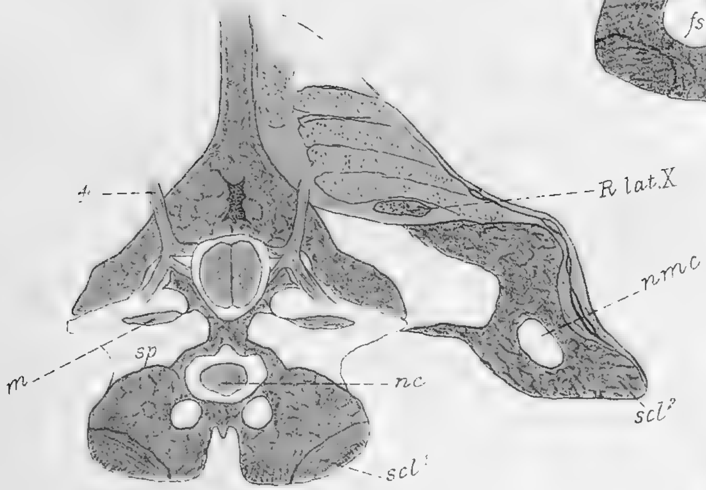

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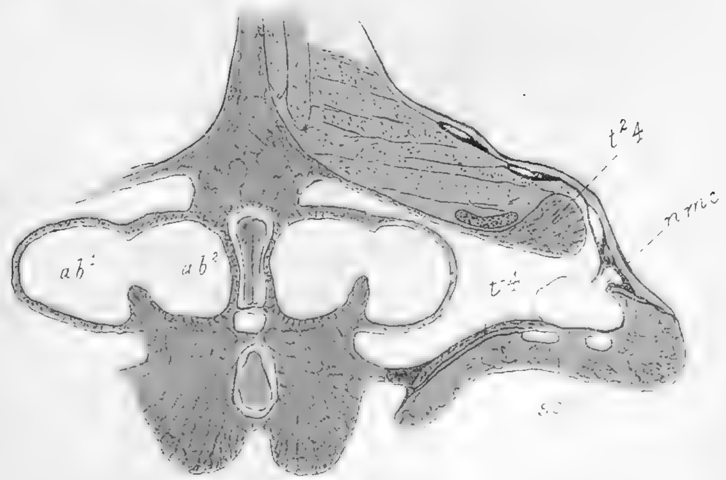

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